FANUC AC SPINDLE MOTOR α series

PARAMETER MANUAL

B-65160E/02

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In this manual, we endeavor to include all pertinent matters.
There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume.
It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

PREFACE

This manual describes the spindle parameters for the FANUC servo amplifier α series.

Chapter 1 describes the parameters used to start normal operation. Chapter 2 describes the parameters for each function. Chapter 3 describes each spindle parameter in detail.

The parameter numbers used in this manual are those for the FANUC Series 16**i**/16, unless noted otherwise. When using another series, modify the parameter specification as necessary. The table below lists the abbreviations used to indicate different series in the descriptions of parameters.

<table>
<tr><th>Series</th><th colspan="2">Abbreviation used in text</th><th colspan="2">Abbreviation used in tables</th></tr>
<tr><td>FANUC Series 0–T</td><td>Series 0–T</td><td rowspan="2">Series 0</td><td>0T</td><td rowspan="2">0</td></tr>
<tr><td>FANUC Series 0–M</td><td>Series 0–M</td><td>0M</td></tr>
<tr><td>FANUC Series 15</td><td colspan="2">Series 15</td><td colspan="2">15</td></tr>
<tr><td>FANUC Series 15i</td><td colspan="2">Series 15i</td><td colspan="2">15i</td></tr>
<tr><td>FANUC Series 16</td><td colspan="2">Series 16</td><td colspan="2" rowspan="11">16i/16</td></tr>
<tr><td>FANUC Series 16i</td><td colspan="2">Series 16i</td></tr>
<tr><td>FANUC Series 18</td><td colspan="2">Series 18</td></tr>
<tr><td>FANUC Series 18i</td><td colspan="2">Series 18i</td></tr>
<tr><td>FANUC Series 21</td><td colspan="2">Series 21</td></tr>
<tr><td>FANUC Series 21i</td><td colspan="2">Series 21i</td></tr>
<tr><td>FANUC Series 20</td><td colspan="2">Series 20</td></tr>
<tr><td>FANUC Series 20i</td><td colspan="2">Series 20i</td></tr>
<tr><td>FANUC Power Mate–MODEL D</td><td colspan="2" rowspan="2">Power Mate–D/F</td></tr>
<tr><td>FANUC Power Mate–MODEL F</td></tr>
<tr><td>FANUC Power Mate i–MODEL D</td><td colspan="2">Power Mate i–D</td></tr>
</table>

Related manuals

The following six kinds of manuals are available for FANUC SERVO MOTOR α series. In the table, this manual is marked with an asterisk (*).

Document name	Document number	Major contents	Major usage	
FANUC AC SERVO MOTOR α series DESCRIPTIONS	B–65142E	• Specification • Characteristics • External dimensions • Connections	• Selection of motor • Connection of motor	
FANUC AC SPINDLE MOTOR α series DESCRIPTIONS	B–65152E	• Specification • Characteristics • External dimensions • Connections		
FANUC SERVO AMPLIFIER α series DESCRIPTIONS	B–65162E	• Specifications and functions • Installation • External dimensions and maintenance area • Connections	• Selection of amplifier • Connection of amplifier	
FANUC SERVO MOTOR α series MAINTENANCE MANUAL	B–65165E	• Start up procedure • Troubleshooting • Maintenance of motor	• Start up the system (Hardware) • Troubleshooting • Maintenance of motor	
FANUC AC SERVO MOTOR α series PARAMETER MANUAL	B–65150E	• Initial setting • Setting parameters • Description of parameters	• Start up the system (Software) • Turning the system (Parameters)	
FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL	B–65160E	• Initial setting • Setting parameters • Description of parameters		*

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APPENDIX

I. FANUC AC SPINDLE MOTOR α series

1 ADJUSTMENT

1.1 START–UP PROCEDURE

A. Check the spindle–related specifications.
- CNC model
- Spindle motor
- Power supply module
- Spindle amplifier module
- Detector system

B. Check all connections.
(See “Connection” in the Descriptions (B–65162E).)

C. Prepare and check the PMC ladder program.
(See “Spindle Control Signals” in the Descriptions (B–65162E).)

D. Check the CNC parameter setting for using the α series (Serial) spindle. (See Section 1.2.1.)

E. Perform automatic α series (Serial) spindle parameter initialization.
(See Section 1.2.2.)
- Set a motor model code and the parameter enabling use of the automatic parameter initialization function, then turn the CNC off and then on again.

F. Change parameter data (when no model code is used).
- For a motor for which there is no model code, perform automatic initialization by specifying 0 (or 64 when the speed range switching function is used), then change the parameter data according to the parameter list for the motor.

G. Set the parameters related to the spindle speed commands and detectors. (See Sections 1.2.3 and 1.2.4.)

H. When using a machine in a system that has already been started, load all CNC parameters for the machine.

I. Check the waveforms of the feedback signals from detectors.
(Refer to the maintenance manual.)

J. Check the operation in normal operation mode.

K. Check the operation of each function.

1.2 PARAMETERS RELATED TO START–UP

1.2.1 Parameters for the α Series (Serial) Spindle System

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st spindle	2nd spindle	1st spindle	2nd spindle			
– (*1)	– (*1)	5606 #0	5606 #1	5606 #0	– (*1)	Whether to use α series (Serial) spindle amplifiers
0071 #4		5604 #0		5841 (*2)	3701 #4	Number of α series (Serial) spindle amplifiers connected

*1 Optional parameter
*2 For Series 15–*i*, specify an axis number in No. 5841.

1.2.2 Automatic Spindle Parameter Initialization

(1) Parameter list

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st spindle	2nd spindle	1st spindle	2nd spindle			
6519 #7	6659 #7	5607 #0	5607 #1	5607 #0	4019 #7	Function for automatically initializing α series (Serial) spindle parameters
6633	6773	3133	3273	3133	4133	Motor model code

When spindle switching control is used with a single spindle amplifier to switch between two motors, see Section 2.7 for information about automatic parameter initialization for the motor on the subspindle side.

(2) Procedure for automatic spindle parameter initialization
Perform automatic spindle parameter initialization by following the procedure below.

1. Set the model code for the desired motor for automatic parameter initialization. The model codes are listed in Appendix C.

For a motor for which there is no model code, follow the procedure below.

(a) Perform automatic parameter initialization using a model code for which the parameter data is similar, then manually change the parameter data as required.

(b) When there is no model code for which the parameter data is similar, set model code 0 (or 64 when the speed range switching function is used) for automatic parameter initialization, then manually change the parameter data according to the parameter list for each model.

Parameter No.						Settings
0		15		15*i*	16*i*/16	
1st spindle	2nd spindle	1st spindle	2nd spindle			
6633	6773	3133	3273	3133	4133	Model code

2. Set the relevant parameter to 1 to enable automatic spindle parameter initialization.

Parameter No.						Settings
0		15		15*i*	16*i*/16	
1st spindle	2nd spindle	1st spindle	2nd spindle			
6519 #7	6659 #7	–	–	–	4019 #7	1
–	–	5607 #0	5607 #1	5607 #0	–	0

NOTE
This bit is reset to its original value after automatic parameter initialization.

3. Turn the CNC off, then on again. Then, the spindle parameters specified with a model code are automatically initialized.
4. When no model code is available, manually change the parameter data according to the parameter list for each model.

(3) Procedure for setting parameters for spindle HRV control
1. Set model code 0 (or 64 for models with the output switching function) for automatic parameter setting. (To keep an adjusted parameter unchanged, avoid carrying out automatic setting.)
2. Manually input the parameters, with reference to Appendix C, ”Motor Model–Specific Parameters.”
3. Set the detector–related parameters, according to the configuration of the detector.
4. To make the spindle HRV control parameters effective, turn off and on the CNC.

NOTE
The spindle HRV control parameters are valid with the following spindle amplifiers and spindle software:
Spindle amplifier drawing number :
A06B–6102–Hxxx#H520
A06B–6104–Hxxx#H520
Spindle software series : 9D20

1.2.3 Parameters Related to Spindle Speed Commands

(1) List of parameters for spindle speed commands

Parameter No.					Description
0T	0M	15	15*i*	16*i*/16	
0013 #7, 6		–	–	3706 #7, 6	Spindle speed command polarity (enabled when input signal SSIN is set to 0)
–	0543 (*1)	5618		3735	Minimum clamp speed of spindle motor
–	0542 (*1)	5619		3736	Maximum clamp speed of spindle motor
6520		3020		4020	Maximum spindle speed
0539	0577	5613	5613	–	Spindle speed command offset (always set to 0)
0516		5614	5614	–	Spindle speed command gain adjustment (always set to 1000)
0540 to 0543	0541 0539 0555 (*2)			3741 to 3744	Maximum spindle speed corresponding to the gear

*1 Supported for the M series only. These parameters are disabled, however, when the constant surface speed control option is used.

*2 When the constant surface speed control option is used with the M series, the same parameter numbers as for the T series (No. 0540 to No. 0543) are used.

(2) Outline of spindle speed command processing for Series 0-C

In both the T and M series, actual output is not performed until the direction of rotation is determined by the parameters (No. 13#7 and 13#6 TCW CWM) or by the PMC signals(SSIN, SSGN) and the M03 or M04 command.

If SSIN is 1, the direction of rotation is determined from SSGN. If SSIN is 0 and parameters TCW and CWM are set so as to determine the direction of rotation by M03 or M04, actual output is not performed unless M03 or M04 is specified even once after the NC power is turned on.

If plus or minus setting is made, instead of M03 and M04, actual output is performed only by an S code. In this case, it is not necessary to specify M03 or M04.

(a) T series (lathe)

(i) Sxxxxx is specified in min^{-1} by the program or with the MDI.

(ii) Speed command data is calculated using the maximum spindle speed (4096 min^{-1}) set in a parameter selected according to the gear selection signal (one of four: GR1 and GR2 combinations at input signal).

Set spindle speed command offset compensation parameter No. 539 to 0, and spindle speed command gain parameter No. 516 to 1000.

GR1 GR2 Maximum spindle speed
(Spindle speed when the maximum motor speed is specified)

0	0	Parameter No. 540
0	1	Parameter No. 541
1	0	Parameter No. 542
1	1	Parameter No. 543

(iii) The data calculated in (ii) is output to output signal: F172 (R08O to R01O) and F173 (R12O to R09O).

(iv) The spindle speed data is transferred to the αseries (Serial) spindle according to the SIND (input signal) state.

0: The maximum spindle speed is converted to ±16384 according to the data calculated in (ii), then the result is transferred to the αseries (Serial) spindle.

1: The maximum spindle speed is converted to ±16384 according to the data (±4095) in input signal: G124 (R08I to R01I) and G125 (R12I to R09I), then the result is transferred to the αseries (Serial) spindle.

(v) The polarity of the speed command can be specified according to the SSIN (input signal) signal as follows:

0: The polarity is determined by parameter Nos. 13#7 and 13#6, and M03 and M04.

1: The polarity is determined by SGN (input signal) .

(vi) For constant surface-speed control, the spindle speed (in min^{-1}) is calculated from G96, Sxxxxx (m/min.) and the position on the X axis, then steps (ii) to (iv) are performed.

(vii) ∗SSTP (input signal): Spindle stop signal

0: S0 is output to F172 and F173 regardless of the command.

1: Normal steps (ii) and (iii) are performed.

∗SSTP works on the value S on the command. It exists between (i) and (ii), and functions in a portion where the S code value specified by program or with the MDI is recognized in the CNC.

If ∗SSTP is 0, the resulting output to F172 and F173 is set to 0. If SIND is 1 and values are set in G124 and G125, however, the spindle is rotated.

(b) M series (machining center)

(i) In the T series, the gear selection signals are input signals. In the M series, they are output signals. With the T series, one of four gear stages is selected by two bits. With the M series, one of three gear signals GR1O, GR2O, and GR3O, and the SF signal (to indicate the change of the gear signal) are output.

Set spindle speed command offset compensation parameter No. 577 to 0, and spindle speed command gain parameter No. 516 to 1000.

Gear	Maximum spindle speed (spindle speed when the maximum motor speed is specified)	
GR1O	Parameter No. 541	: Low
GR2O	Parameter No. 539	: Middle
GR3O	Parameter No. 555	: High

To clamp the maximum spindle speed command, set parameter No. 542.
In normal operation, set 4095 (to output up to 10 V).
To clamp the minimum spindle speed command, set parameter No. 543.
In normal operation, set 0.
For type B gear change, the motor speed at gear change must be set in the following parameters:

Parameter No. 585
(For the maximum motor speed with the low gear)
Parameter No. 586
(For the maximum motor speed with the middle gear)

(ii) Sxxxxx (in min^{-1}) is specified by the program or with the MDI.

(iii) In reply to the S command, the CNC outputs SF and either GR1O, GR2O, or GR3O. At the same time, by using the maximum spindle speed (in min^{-1}) set in the corresponding parameter to the set gear, the CNC calculates speed command data. The maximum spindle speed is assumed to be 4096. The calculated data is then output to output signal: F172 (R08O to R01O) and F173 (R12O to R09O).

(iv) According to the SIND (input signal) state, the spindle speed data is transferred to the αseries (Serial) spindle.

0: Based on the data calculated in (iii), the maximum spindle speed is converted to ±16384, then it is transferred to the αseries (Serial) spindle.

1: Based on the data (±4095) in input signal: G124 (R08I to R01I) and G125 (R12I to R09I), the maximum spindle speed is converted to ±16384, then it is transferred to the α series (Serial) spindle.

(v) The polarity of the speed command can be specified according to the SSIN (input signal) state as follows:

0: The polarity is determined by parameter Nos. 13#7 and 13#6, and M03 or M04.

1: The polarity is determined by the SGN (input signal) signal.

(vi) ∗SSTP functions in the same way as the T series.

(vii) The SOR (input signal) is provided for gear change. If SOR is 1 and ∗SSTP is 0, the spindle rotates at a constant speed specified by the speed command set in the parameter. In the M series, either the spindle or spindle motor can be turned at constant speed. One of them can be selected by parameter No. 3#5 GST.

The T series also provides SOR. Unlike from SOR in the M series, SOR in the T series always causes the spindle to rotate at constant speed.
In addition to the gear change point mentioned above, other switch points can be provided in G84 and G74 (tapping mode).(Set parameter No. 12#6 G84S, and Nos. 540 and 556).

The M series can have the constant surface-speed control option. This allows the M series to function as the same gear shift type as the T series.

The M series, when provided with the constant surface-speed control option, is compatible with the T series, except for two features. One of the differences is that in the M series, the reference axis for calculating the surface speed can be set to either the X, Y, Z, or 4th axis by the program or parameters. The other difference is that in the T series, the maximum speed is clamped by the program at G50SXXXXX. In the M series, it is clamped at G92SXXXXX. (Gear shift of the M series type is not permitted when constant surface-speed control is provided.)

(3) Outline of spindle speed command processing for Series 15 (common to the T and M series)

The α series (Serial) spindle allows the BMI interface only. Basically, the PMC calculates and sends the contents of the spindle motor speed command to the CNC. In general, spindle control SPCNT (machine instruction) of the PMC is used.

(a) Sxxxxx (in min^{-1}) is specified by the program or with the MDI.

(b) Sxxxxx (in min^{-1}) is output to output signal: F20 to F23 (32 bits) without modification.

(c) The PMC sets data, which is calculated with the maximum motor speed assumed to be ±8192, in RI (input signal): G24 and G25 by using a machine instruction.

Parameters such as maximum spindle speed for the set gear stage (one of four stages) and spindle override must be set in the machine instruction.

(d) Based on the RI data (±8192), the CNC performs processing related to the following two parameters, converts the maximum motor speed into 16384, then transfers it to the α series (Serial) spindle.

Spindle speed command offset compensation parameter
No. 5613 = 0

Spindle speed command gain parameter No. 5614 = 1000

(e) When functions such as spindle change detection and constant surface speed control are used, the following parameters are also used:

Gear	Maximum spindle speed (spindle speed when the maximum motor speed is specified)
Gear 1	: Parameter No. 5621
Gear 2	: Parameter No. 5622
Gear 3	: Parameter No. 5623
Gear 4	: Parameter No. 5624

(4) Outline of spindle speed command processing for Series 16

The spindle control flow for Series 16 is almost the same as that for Series 0-C. Note that the parameter Nos. indicated above for the T and M systems of Series 0-C are different for Series 16.

A major difference in Series 16 is spindle override. The conditions for spindle override are the same as in Series 0-C. Spindle override is enabled where ∗SSTP and the command S code are recognized in the CNC.The PMC signal, however, is treated in a different way.

In Series 0-C, override is done in 10% steps by a 3-bit signal. If all bits are set to 0, 100% override is achieved. In Series 16, the amount of override applied in steps of 1% is set in binary representation by using the eight bits of G30 (0% to 255%). With Series 0-C, 100% override can be applied automatically without special operation. With Series 16, 0% spindle override is always applied unless the override is set by the PMC.

If SIND is 1, spindle override is disabled.

(a) T series (lathe)

(i) Sxxxxx is specified in min^{-1} by the program or with the MDI.

(ii) Sxxxxx is output in min^{-1} to output signal: F22 to F25 (32 bits) without modification.

(iii) By using the maximum spindle speed (min^{-1}) set in the parameter corresponding to the gear selection signals (one of four stages is selected by input signal: GR1 and GR2), the speed command data is calculated. The maximum spindle speed is assumed to be 4096.

Spindle speed command offset compensation parameter No. 3731=0

Spindle speed command gain parameter No. 3730=1000

GR1	GR2	Maximum spindle speed (spindle speed when the maximum motor speed is specified)
0	0	Parameter No. 3741
0	1	Parameter No. 3742
1	0	Parameter No. 3743
1	1	Parameter No. 3744

(iv) The data calculated in (iii) is output to output signal: 36 (R08O to R01O) and F37 (R12O to R09O).

(v) The spindle speed data is transferred to the αseries (Serial) spindle according to the SIND (input signal) state as follows:

0: The maximum spindle speed is converted to ±16384 according to the data calculated in (iii), then the result is transferred to the αseries (Serial) spindle.

1: The maximum spindle speed is converted to ±16384 according to the data (±4095) in input signal:
G32 (R08I to R01I) and G33 (R12I to R09I), then the result is transferred to the α series (Serial) spindle.

(vi) The polarity of the speed command can be specified by SSIN (input signal) as follows:

0: The polarity is determined by parameter Nos. 3706#7 and 3706#6, and M03 and M04.

1: The polarity is determined by the SGN (input signal) .

(vii) For constant surface-speed control, the spindle speed is calculated in min^{-1} from G96, Sxxxxx (m/min.) and the position on the X axis, then steps (iii) to (v) are performed.

(viii) ∗SSTP (input signal): Spindle stop signal

0: S0 is always output regardless of the command.

1: Normal processing steps (iii) and (iv) are performed.

(b) M series (machining center)

(i) In the T series, the gear selection signals are input signals. In the M series, they are output signals. In the T series, one of four gear stages is selected by two bits. In the M series, one of three gear signals GR1O, GR2O, and GR3O, and the SF signal (to indicate the change of the gear signal) are output.

Spindle speed command offset compensation parameter No. 3731=0

Spindle speed command gain parameter No. 3730=1000

Gear	Maximum spindle speed (spindle speed when the maximum motor speed is specified)
GR1O	Parameter No. 3741
GR2O	Parameter No. 3742
GR3O	Parameter No. 3743
———	Parameter No. 3744

When M series gear shift is used, parameter No. 3744 becomes valid.

The parameter is valid when the constant surface speed control function is used in the M series.

To clamp the maximum spindle speed command, normally set parameter No. 3736 to 4095 (to output up to 10 V).

To clamp the minimum spindle speed command, normally set parameter No. 3735 to 0.

For type B gear change, the motor speed at gear change must be set in the following parameters:

Parameter No. 3751
(for the maximum motor speed with gear 1)
Parameter No. 3752
(for the maximum motor speed with gear 2)

(ii) Sxxxxx is specified in min^{-1} by the program or with the MDI.

(iii) In reply to the S command, the CNC outputs SF and either GR1O, GR2O, or GR3O. At the same time, by using the maximum spindle speed (min^{-1}) set in the corresponding parameter to the set gear, the CNC calculates speed command data. The maximum spindle speed is assumed to be 4096. The calculated data is then output to output signal: F36 (R08O to R01O) and F37 (R12O to R09O).

(iv) According to the SIND (input signal) state, the spindle speed data is transferred to the αseries (Serial) spindle.

0: Based on the data calculated in (iii), the maximum spindle speed is converted to ±16384, then it is transferred to the αseries (Serial) spindle.

1: Based on the data (±4095) in input signal: G32 (R08I to R01I) and G33 (R12I to R09I), the maximum spindle speed is converted to ±16384, then it is transferred to the αseries (Serial) spindle.

(v) The polarity of the speed command can be specified according to the SSIN (input signal) state as follows:

0: The polarity is determined by parameter Nos. 3706#7 and 3706#6, and M03 or M04.

1: The polarity is determined by the SGN (input signal).

(vi) The SOR (input signal) is provided for gear change. If SOR is 1, the spindle rotates at a constant speed specified by the speed command set in the parameter.

1.2.4 Parameters Related to Detectors

(1) List of parameters for detectors

Parameter No.					Description
0T	0M	15	15*i*	16*i*/16	
6500 #0		3000 #0	3000 #0	4000 #0	Direction of spindle and motor rotation
6511 #2, 1, 0		3011 #2, 1, 0	3011 #2, 1, 0	4011 #2, 1, 0	Motor speed detector setting
6503 #1		3003 #1	3003 #1	4003 #1	Whether to use a MZ sensor or BZ sensor
6504 #4		3004 #4	3004 #4	4004 #4	Type of a MZ sensor
6504 #1		3004 #1	3004 #1	4004 #1	Whether to use a BZ sensor mounted onto the spindle
6501 #2		3001 #2	3001 #2	4001 #2	Whether to use a position coder signal
6500 #2		3000 #2	3000 #2	4000 #2	Position coder mounting direction
6503 #7, 6, 5, 4		3003 #7, 6, 5, 4	3003 #7, 6, 5, 4	4003 #7, 6, 4	Position coder signal setting
0003 #7, 6	0028 #7, 6	5610		3706 #1, 0	Gear ratio between the spindle and position coder (X1, X2, X4, X4, X8)
6501 #5		3001 #5	3001 #5	4001 #5	Whether to use a detector for Cs contouring control
6501 #6		3001 #6	3001 #6	4001 #6	Detector setting when the Cs contouring control function is used with a built–in motor
6504 #0		3004 #0	3004 #0	4004 #0	Whether to use a high–resolution position coder
6501 #7		3001 #7	3001 #7	4001 #7	Mounting direction of detector for Cs contouring control
6507 #5		3007 #5	3007 #5	4007 #5	Whether to detect disconnection of signals from a detector for Cs contouring control and a position coder
6556 to 6559		3056 to 3059	3056 to 3059	4056 to 4059	Spindle–to–motor gear ratio data (This data is selected by spindle control input signals CTH1A and CTH2A.)
6504 #2		3004 #2	3004 #2	4004 #2	Whether to use a reference switch signal
6504 #3		3004 #3	3004 #3	4004 #3	Setting of the detection edge of a reference switch signal
6518 #4		3018 #4	3018 #4	4018 #4	Whether to use α sensor Cs contour control function

(2) Detail of parameter for detector

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6500	3000	3000	4000	DEFRTO					POSC1		ROTA1
2nd–	6640	3140										

ROTA1: Indicates the relationship between the rotation directions of spindle and spindle motor.

0: Rotates the spindle and spindle motor in the same direction.

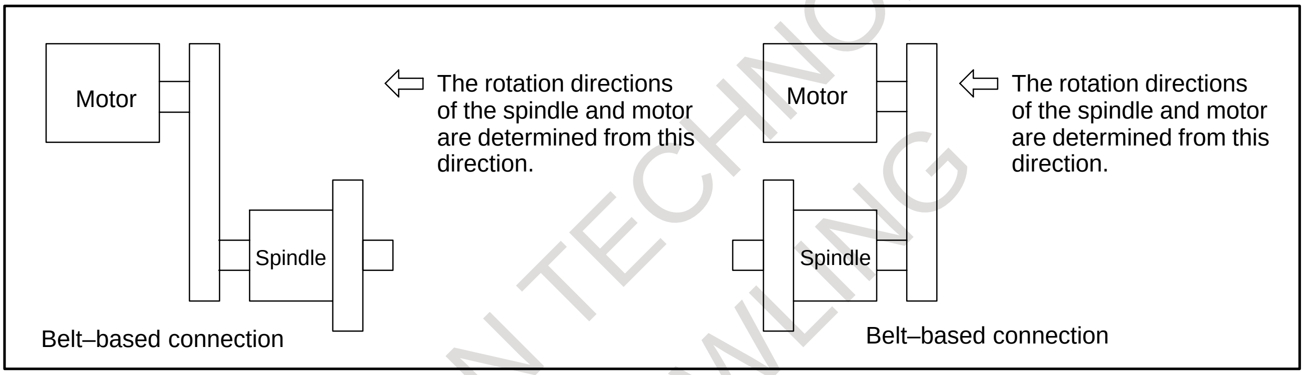
1: Rotates the spindle and spindle motor in the reverse direction.

Judge the spindle rotation direction in the same state as that when the motor rotation direction was judged from the motor shaft direction.

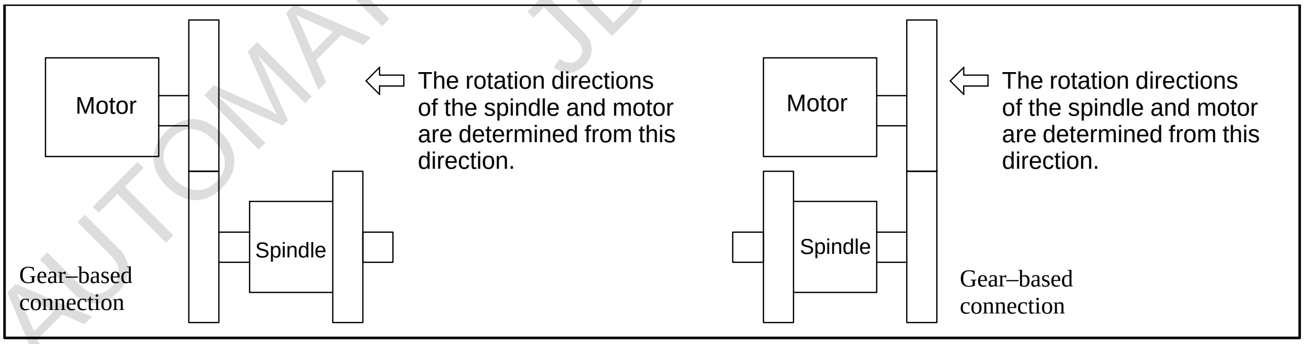
For a built–in motor, set the bit to 0 (same direction).

Examples of rotation direction of spindle and motor:

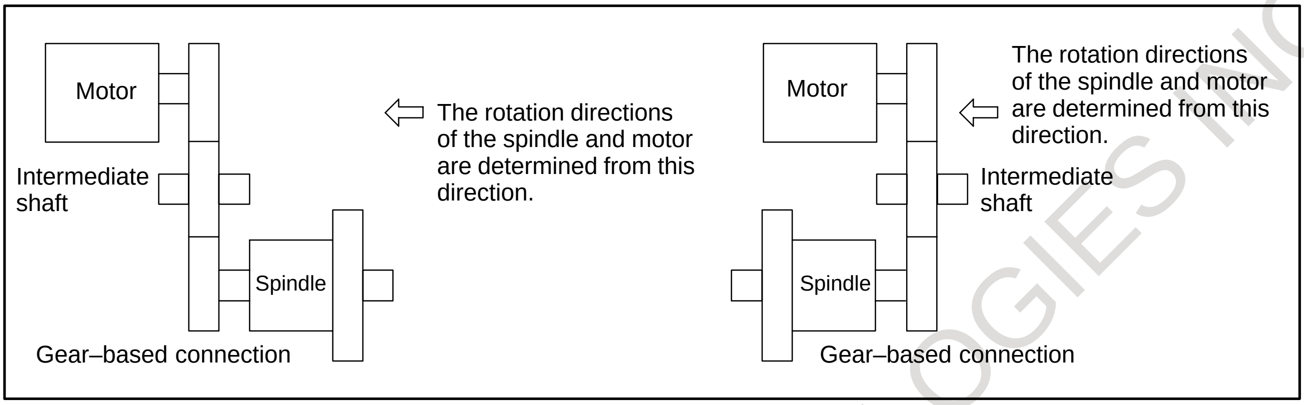
(a) When the spindle and motor are connected by a belt, the spindle and motor rotate in the same direction, regardless of the orientation of the spindle.



(b) When the spindle and motor are connected by a gear (with no intermediate shaft), the spindle and motor rotate in opposite directions, regardless of the orientation of the spindle.



(c) When the spindle and motor are connected by a gear with an intermediate shaft, the spindle and motor rotate in the same direction, regardless of the orientation of the spindle.



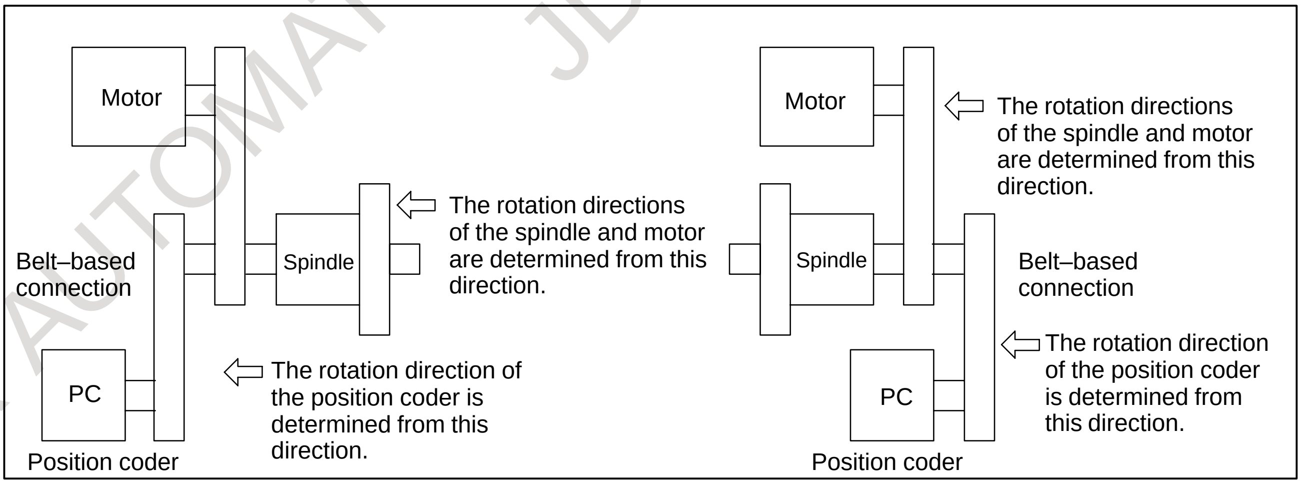
POSC1: Indicates the mounting direction of position coder.

0: Rotates the spindle and position coder in the same direction.

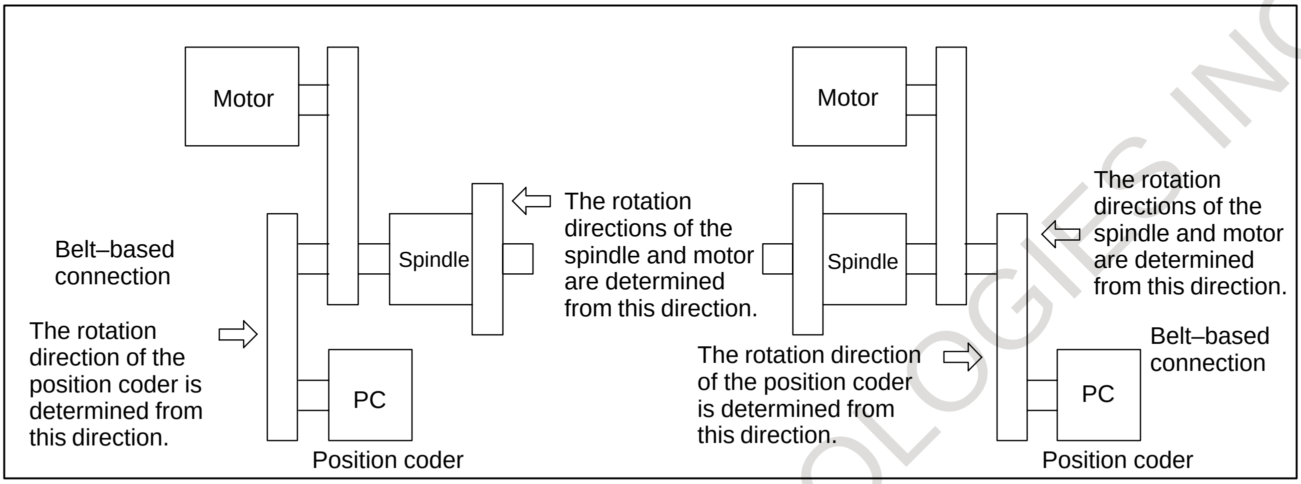
1: Rotates the spindle and position coder in the reverse direction.

Judge by rotation direction when position coder rotation direction is viewed from position coder shaft.
Determine the rotation direction of the position coder by viewing the shaft of the position coder from the near side. Determine the rotation direction of the spindle by viewing the motor and spindle from the same direction (usually, from the near side).
For a built–in motor, set the bit to 0 (same direction).
Examples of the rotation direction of the spindle and position coder:

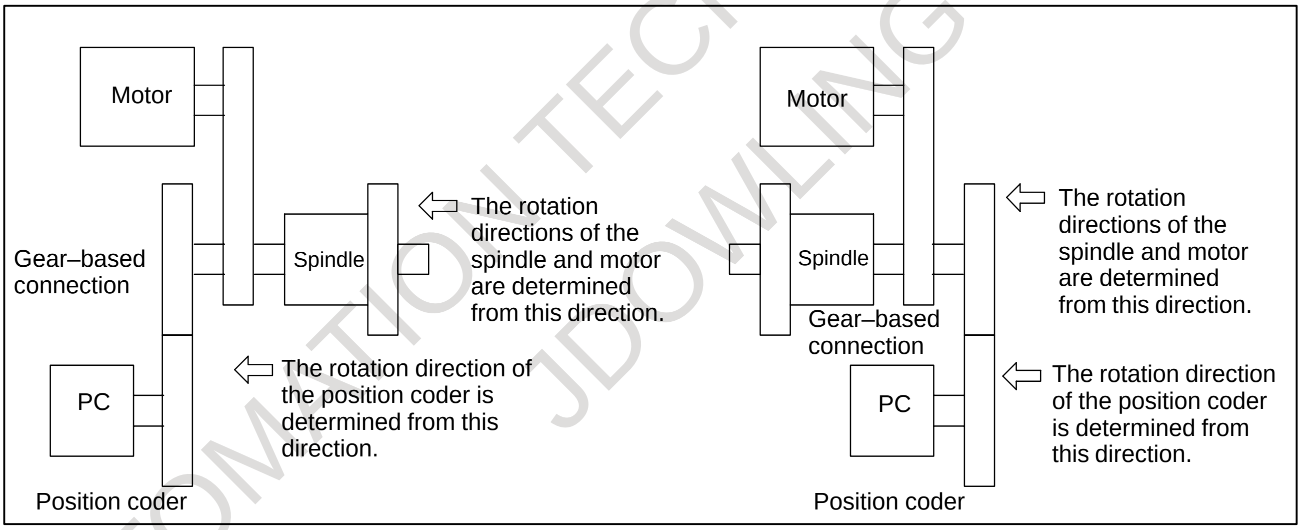
(a) When the spindle and position coder are connected by a belt as shown below, the spindle and position coder rotate in the same direction.



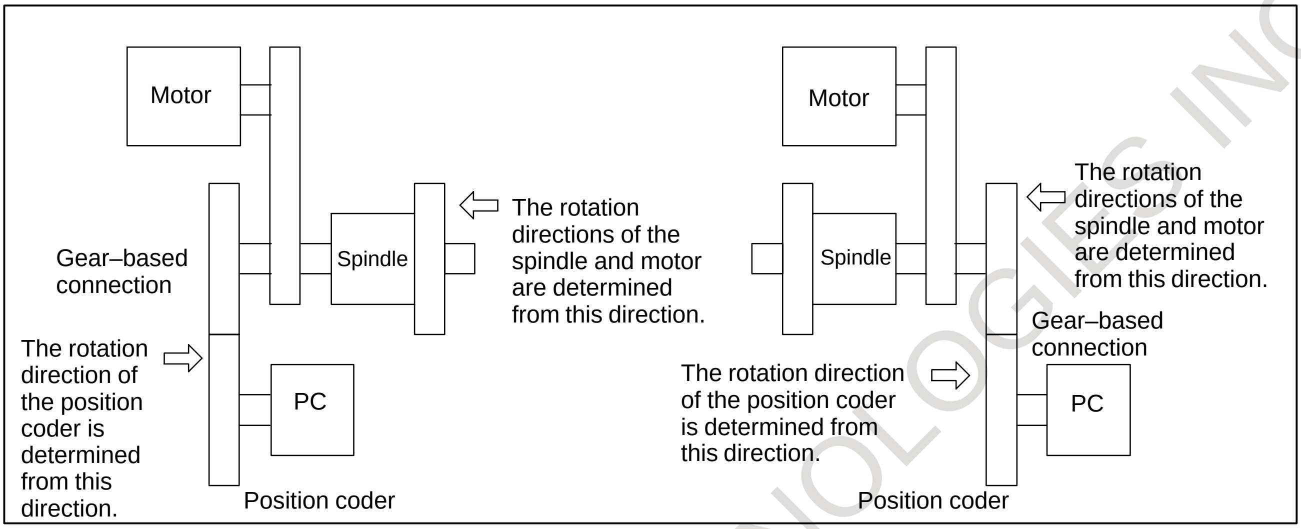
(b) When the spindle and position coder are connected by a belt as shown below, the spindle and position coder rotate in opposite directions.



(c) When the spindle and position coder are connected by a gear as shown below, the spindle and position coder rotate in opposite directions.



(d) When the spindle and position coder are connected by a gear as shown below, the spindle and position coder rotate in the same direction.



DEFRTO:

Indicates the number of position coder pulses of the other spindle in differential mode

0:1024 p/rev × 4 (4096 p/rev)

1:512 p/rev × 4 (2048 p/rev)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6501	3001	3001	4001	CAXIS3	CAXIS2	CAXIS1		MGSEN	POSC2		
2nd–	6641	3141										

Standard setting: 0 0 0 0 0 0 0 1

POSC2: Determines whether the POSITION CODER signal is used or not.

0 : Not used.

1 : Used.

Set this bit to ”1” when using the following functions:

- Position coder spindle orientation
- Rigid tapping
- Spindle synchronization control
- Feed per revolution
  (Normal thread cutting constant surface speed control)
- Spindle calculation function with position coder
  (Spindle positioning)
- When displaying number of spindle rotation (SACT display)

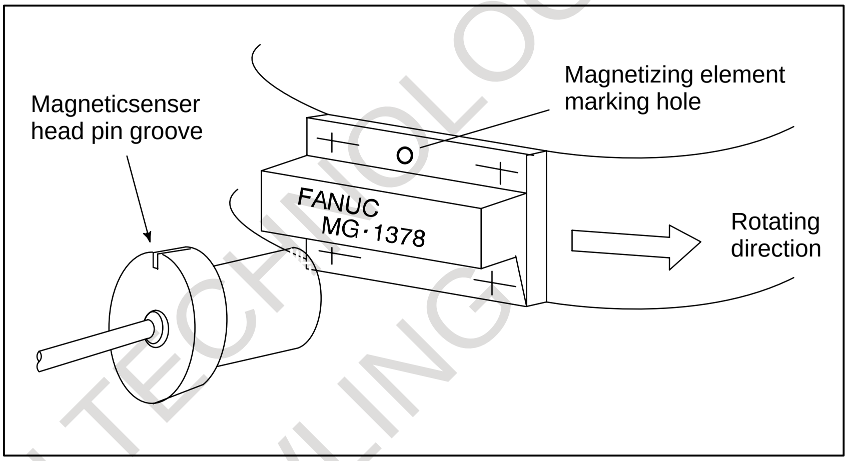
Beware that if this bit is set to ”Use=1” with no POSITION CODER signal input, then the POSITION CODER disconnection alarm (AL-27) will ring.

MGSEN: Indicates the mounting direction of magnetic sensor.

0: Rotates the motor and magnetic sensor in the same direction.

1: Rotates the motor and magnetic sensor in the reverse direction.

The normal rotation command (SFRA = 1) rotates the spindle motor counterclockwise (CCW) when the motor shaft is viewed from the near side.
Align the magnetizing element marking hole and the magnetic sensor pin groove so that the magnetizing element and magnetic sensor rotate as shown below when SFRA = 1.
In this case, set this bit to 0.
Set this bit to 1 for the reverse rotation direction.



CAXIS1: Determines whether the high-resolution magnetic pulse coder is used or not.

0: Not used.

1: Used.

Set for 1 if it is with Cs contouring control function is used.
Set for 1 if it is with high–resolution position coder.

CAXIS2: Also used in speed detection of the position detection signal for Cs contour control.

0: Not used. (when spindle and spindle motor are separated)

1: Used. (in case of built-in spindle motor)

CAXIS3: Indicates the mounting direction of the position detector for Cs contour control.

The Power Mate does not have this function.

0: Rotates the spindle and position detection in the same direction.

1: Rotates the spindle and position detection in the reverse direction.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6502	3002	3002	4002						CSDET3	CSDET2	CSDET1
2nd–	6642	3142										

CSDET3-1:

Cs contouring control resolution setting.
(The bits of this parameter are invalid when α sensor Cs contour control function is used.)

CSDET3	CSDET2	CSDET1	Cs contouring control resolution
0	0	0	360000p/rev.
0	0	1	180000p/rev.
0	1	0	120000p/rev.
0	1	1	90000p/rev.
1	0	0	60000p/rev.
1	0	1	40000p/rev.
1	1	0	20000p/rev.
1	1	1	10000p/rev.

(To be set to 000 usually)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6503	3003	3003	4003	PCPL2	PCPL1	PCPL0	PCTYPE			PCCNCT	PCMGSL
2nd–	6643	3143										

PCMGSL:

Selection of position coder method/magnetic sensor method spindle orientation

0: Position coder method spindle orientation function

1: Magnetic sensor method spindle orientation function

Set this bit to 1 to use the magnetic sensor method spindle orientation. Before this function can be used, the CNC software option of the spindle orientation function must be selected.

PCCNCT:

Specifies whether a MZ sensor or BZ sensor (built–in motor) in a motor is used.

0: Not used.

1: Used.

Set this bit to 1 when a MZ sensor is used. Set this bit to 1 when a built–in motor with a BZ sensor is used.

PCPL2, PCPL1, PCPL0, PCTYPE:

Set a position coder signal.

PCPL2	PCPL1	PCPL0	PCTYPE	MZ sensor, BZ sensor (Built–in sensor)	High–resolution magnetic pulse coder	Others
0	0	0	0	256λ/rev (φ103)	Magnetic drum diameter φ65	Position coder High–resolution position coder
0	0	0	1	128λ/rev (φ52)	—	—
0	1	0	0	512λ/rev (φ205)	φ130	—
0	1	0	1	64λ/rev (φ26)	—	—
1	0	0	0	—	φ195	—
1	1	0	0	384λ/rev (φ154)	φ97.5	—

Set these bits to ”0000” when using a position coder or high–resolution position coder. When a high–resolution magnetic pulse coder is being used, these bits set the signal used for Cs contouring control. If the setting of these bits is invalid, the one–rotation signal detection error alarm (AL–39) occurs.

Motor model and Number of cogs of MZ sensor gear

Motor model	Number of cogs of MZ sensor gear
α0.5	64 λ/rev
α1 to α3 (α6/12000)	128 λ/rev
α6 to α40 αP8 to αP60	256 λ/rev

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6504	3004	3004	4004				BISGAN	RFTYPE	EXTRF	SPDBIS	HRPC
2nd–	6644	3144										

HRPC: Specifies whether a high–resolution position coder is used.

0: Not used.

1: Used.

SPDBIS: Specifies whether a separate BZ sensor is used.

0: Not used.

1: Used.

Set this bit to 1 when a position coder signal is obtained by mounting a BZ sensor onto the spindle without using a position coder. Set the type of built–in sensor with PCPL2, PCPL1, PCPL0, and PCTYPE. Set this bit to 0 when a built–in motor with a BZ sensor is used.

EXTRF: Specifies whether a reference switch signal is used.

0: Not used.

1: Used.

Set this bit to 1 when a motor with a MZ sensor (built–in sensor) is used, and a one–rotation signal is obtained from a reference switch (proximity switch) mounted on the spindle (i.e., spindle orientation with a reference switch is used).

RFTYPE: Specifies whether to invert the external one–turn signal.

0: The final signal is to be inverted.

1: The final signal is not to be inverted.

BISGAN: Specifies (9D00.D) the MZ sensor (built–in sensor) in motor models α0.5, 0.5S, 0.3S, and IP65 (1S to 3S).

0: Other than the case below.

1: Motor models α0.5, 0.5S, 0.3S, and IP65 (1S to 3S) with a MZ sensor

When setting this bit to 1, also set bit 1 (PCCNCT) of parameter No. 4003 to 1.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6507	3007	3007	4007		PCALCH	PCLS					
2nd–	6647	3147										
Standard setting:					0	0	0	0	0	0	0	0

PCLS: Determines high-resolution magnetic pulse coder and position coder signal disconnection detection.

0: Performs disconnection detection. (Normally set to ”0”)

1: Does not perform disconnection detection.

Set it to 0:

AL-26 (High-resolution magnetic pulse coder speed detecting signal disconnection),
AL-27 (Position coder signal disconnection) and
AL-28 (High-resolution magnetic pulse coder speed detecting signal disconnection) are checked.

Set it to ”1” temporarily when adjustment is difficult when adjusting location and speed feedback signal waves and the disconnection alarm occurs. After adjustment reset it to ”0”.

PCALCH:

Enables or disables detection of the alarms (AL-41, 42, 47) related to the position coder signal.

0: Detects the alarms related to the position coder signal.

1: Does not detect the alarms related to the position coder signal.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6511	3011	3011	4011						VDT3	VDT2	VDT1
2nd–	6651	3151										

VDT3-VDT1:

Setting of speed detector

VDT3	VDT2	VDT1	Setting of speed detector	
0	0	0	64λ/rev	
0	0	1	128λ/rev	
0	1	0	256λ/rev	
0	1	1	512λ/rev	
1	0	0	192λ/rev	(9D00.D)
1	0	1	384λ/rev	(9D00.D)

When using a spindle motor with a built–in high–resolution magnetic pulse coder, set 128 λ/rev. When a detector for Cs contouring control is used with a built–in motor, the setting depends on the diameter of the detector drum.

Motor model and Number of cogs of MZ sensor gear

Motor model	Number of cogs of MZ sensor gear
α0.5	64 λ/rev
α1 to α3 (α6/12000)	128 λ/rev
α6 to α40 αP8 to αP60	256 λ/rev

(3) Procedure for setting detector–related parameters

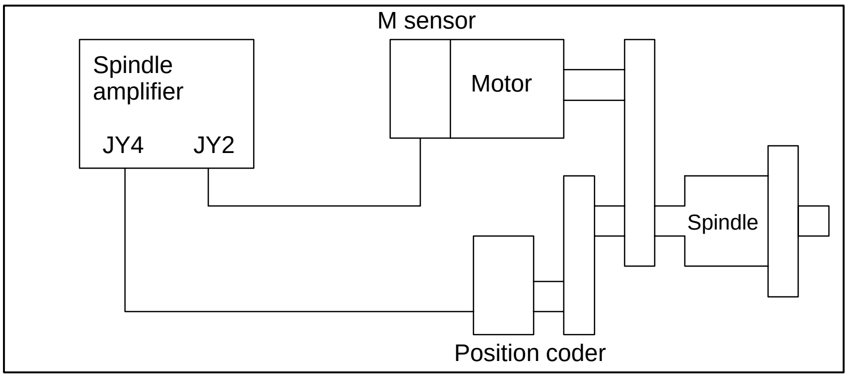
The setting of the parameters used for typical detector configurations is described below.

With the αseries spindle, the detector circuitry hardware is set by parameter setting. This means that alarms such as disconnection or overheat alarms may be output while detector–related parameters are being set.

To initialize the hardware, briefly turn off the amplifier power after setting the detector–related parameters.

(a) When a M sensor in a motor is used together with a position coder

Example system configuration:



1. Connect the feedback signal cables.

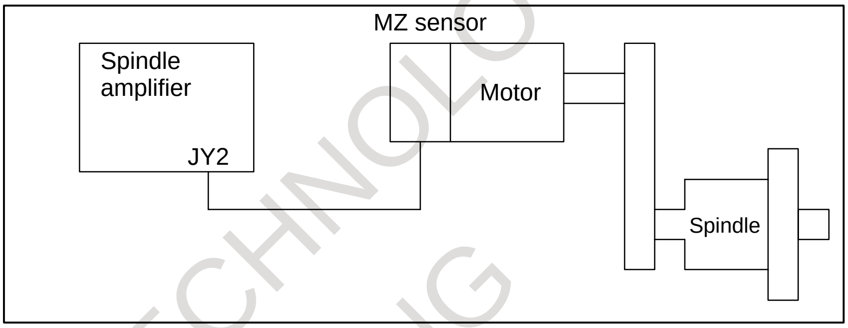
Detector	Connector
M sensor (motor)	JY2
Position coder (spindle)	JY4

2. Set the detector–related parameters.

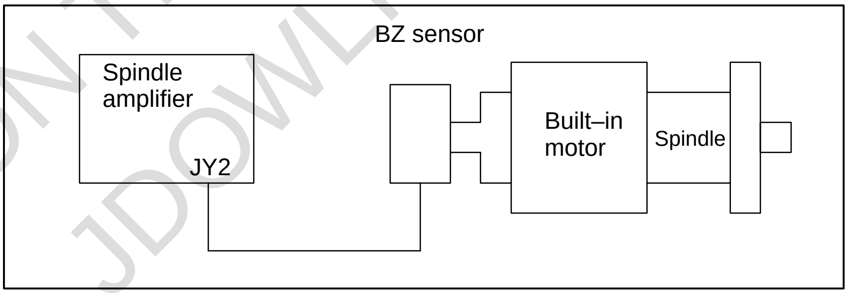
Parameter	Setting	Description
4011 #2, 1, 0	Depends on the detector.	Sets a speed detector.
4003 #7, 6, 5, 4	0, 0, 0, 0	Sets a position coder signal.
4001 #2	1	Uses a position coder signal.

(b) When a MZ sensor or BZ sensor is used

System configuration example 1:



System configuration example 2:



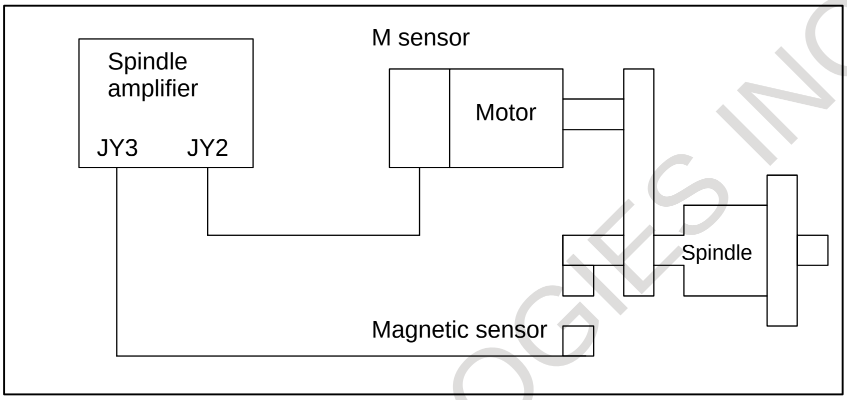
1. Connect the feedback signal cable.

Detector	Connector
MZ sensor, BZ sensor (motor)	JY2

2. Set the detector–related parameters.

Parameter	Setting	Description
4003 #1	1	Uses a MZ sensor or BZ sensor.
4003 #7, 6, 5, 4	Depends on the detector.	Sets a position coder signal.
4004 #4	Depends on the detector.	Sets the type of MZ sensor.
4011 #2, 1, 0	Depends on the detector.	Sets a speed detector.
4001 #2	1	Uses a position coder signal.

(c) When a M sensor is used together with a magnetic sensor
Example system configuration:



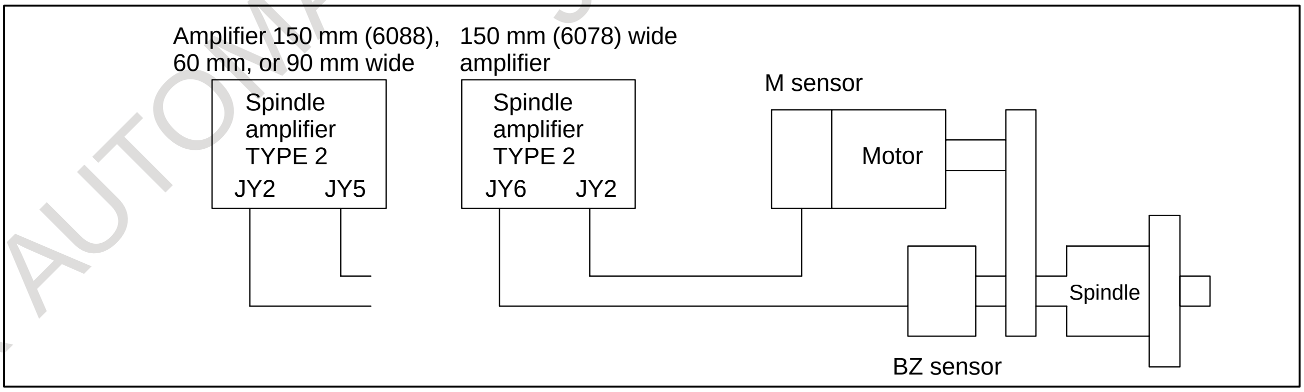
1. Connect the feedback signal cables.

Detector	Connector
M sensor (motor)	JY2
Magnetic sensor (spindle)	JY3

2. Set the detector–related parameters.

Parameter	Setting	Description
4011 #2, 1, 0	Depends on the detector.	Sets a speed detector.
4003 #0	1	Selects the magnetic sensor method orientation.
4078	Depends on the detector.	Sets an MS signal constant.
4079	Depends on the detector.	Sets an MS signal gain constant.

(d) When a M sensor is used together with a separate BZ sensor
Example system configuration:



1. Connect the feedback signal cables.

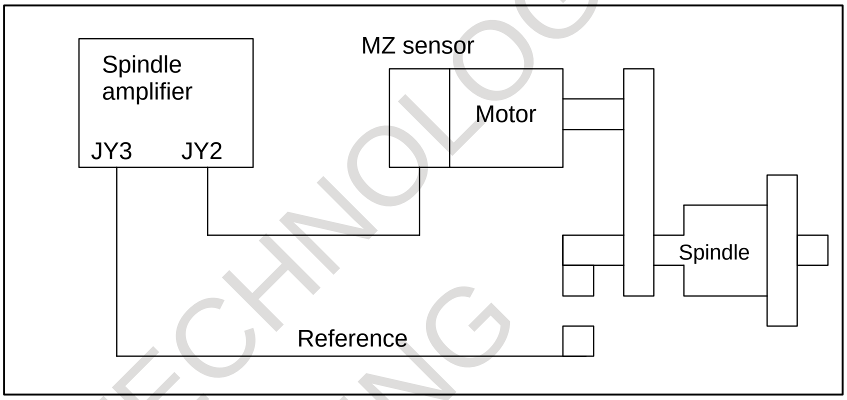
Detector	Connector	
	Amplifier 150 mm (6088),60 mm, or 90 mm wide	Amplifier 150 mm (6078) wide
Pulse generator (motor)	JY5	JY2
Built–in sensor (spindle)	JY2	JY6

2. Set the detector–related parameters.

Parameter	Setting	Description
4004 #1	1	Uses a separate BZ sensor.
4003 #7, 6, 5, 4	Depends on the detector.	Sets a position coder signal.
4011 #2, 1, 0	Depends on the detector.	Sets a speed detector.
4001 #2	1	Uses a position coder signal.

(e) When a built–in sensor in a motor is used together with a reference switch (proximity switch)

Example system configuration:



1. Connect the feedback signal cables.

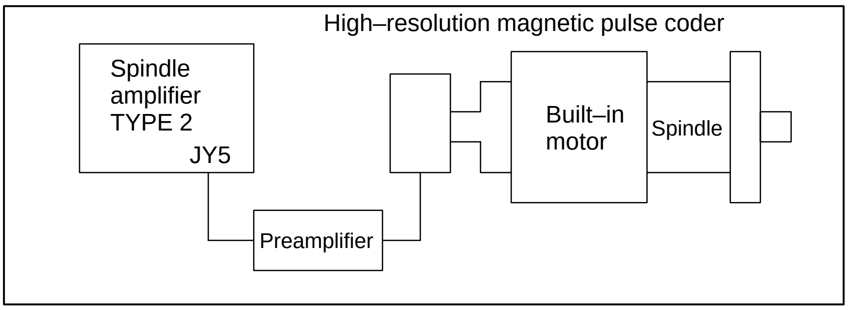
Detector	Connector
MZ sensor (motor)	JY2
Reference switch (spindle)	JY3

2. Set the detector–related parameters. Set (b) above before attempting the setting below.

Parameter	Setting	Description
4004 #2	1	Uses a reference switch.
4004 #3	Depends on the detector.	Sets the detection edge for a reference switch signal.
4001 #2	1	Uses a position coder signal.

(f) When a high–resolution magnetic pulse coder is used (with a built–in motor)

Example system configuration:



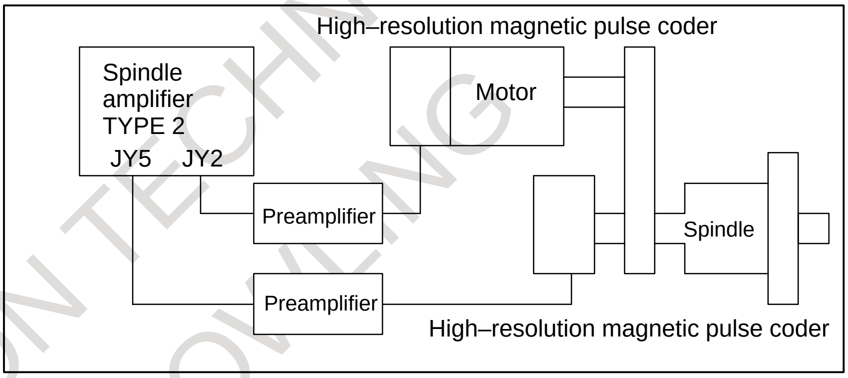
1. Connect the feedback signal cable.

Detector	Connector
High–resolution magnetic pulse coder	JY5

2. Set the detector–related parameters.

Parameter	Setting	Description
4001 #5	1	Uses a high–resolution magnetic pulse coder.
4001 #6	1	Also uses a position detection signal for speed detection.
4003 #7, 6, 5, 4	Depends on the detector.	Sets a position coder signal.
4011 #2, 1, 0	Depends on the detector.	Sets a speed detector.
4001 #2	1	Uses a position coder signal.

(g) When a high–resolution magnetic pulse coder is used (with the spindle and motor separated)
Example system configuration:



1. Connect the feedback signal cables.

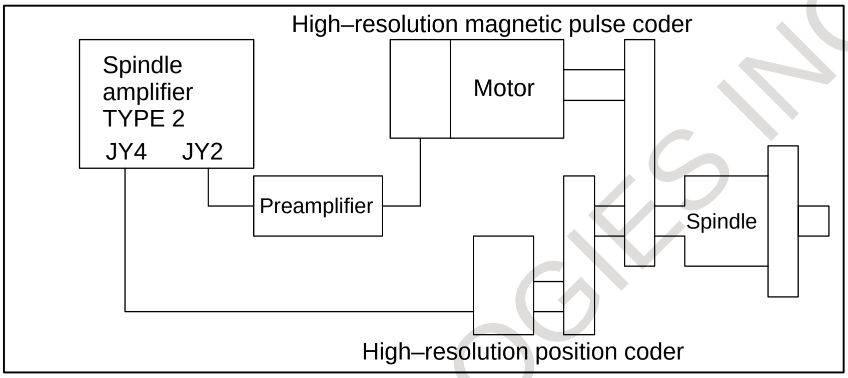
Detector	Connector
High–resolution magnetic pulse coder (motor)	JY2
High–resolution magnetic pulse coder (spindle)	JY5

2. Set the detector–related parameters.

Parameter	Setting	Description
4001 #5	1	Uses a high–resolution magnetic pulse coder.
4003 #7, 6, 5, 4	Depends on the detector.	Sets a position coder signal.
4011 #2, 1, 0	Depends on the detector.	Sets a speed detector.
4001 #2	1	Uses a position coder signal.

(h) When a high–resolution magnetic pulse coder in a motor is used together with a high–resolution position coder

Example system configuration:



1. Connect the feedback signal cables.

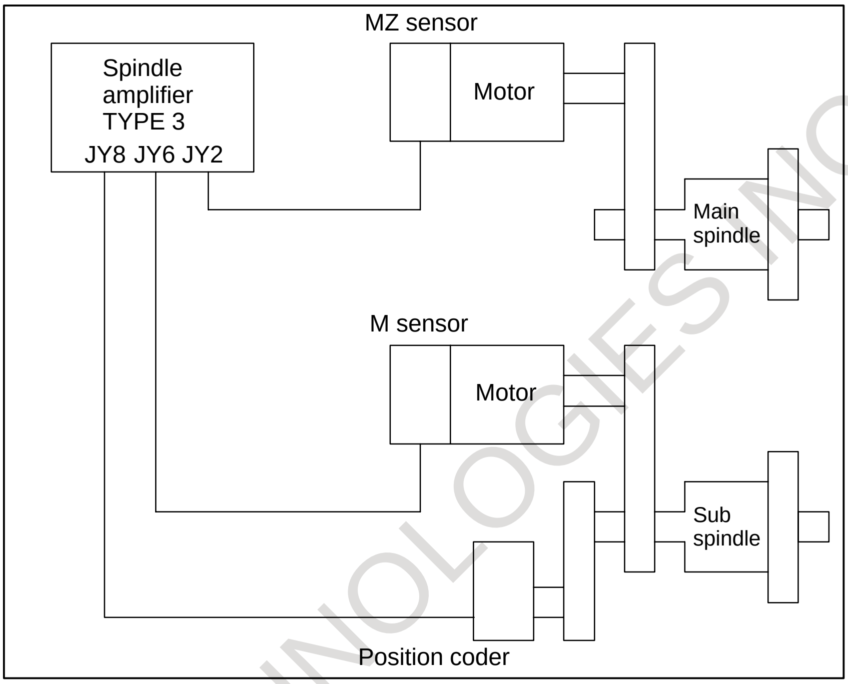
Detector	Connector
High–resolution magnetic pulse coder (motor)	JY2
High–resolution position coder (spindle)	JY4

2. Set the detector–related parameters.

Parameter	Setting	Description
4001 #5	1	Uses a high–resolution magnetic pulse coder.
4004 #0	1	Uses a high–resolution position coder.
4003 #7, 6, 5, 4	0, 0, 0, 0	Sets a position coder signal.
4011 #2, 1, 0	Depends on the detector.	Sets a speed detector.
4001 #2	1	Uses a position coder signal.

(i) When spindle switching control is performed, a built–in sensor is used on the main spindle side, and a pulse generator in a motor and a position coder are used for the subspindle side

Example system configuration:



1. Connect the feedback signal cables.

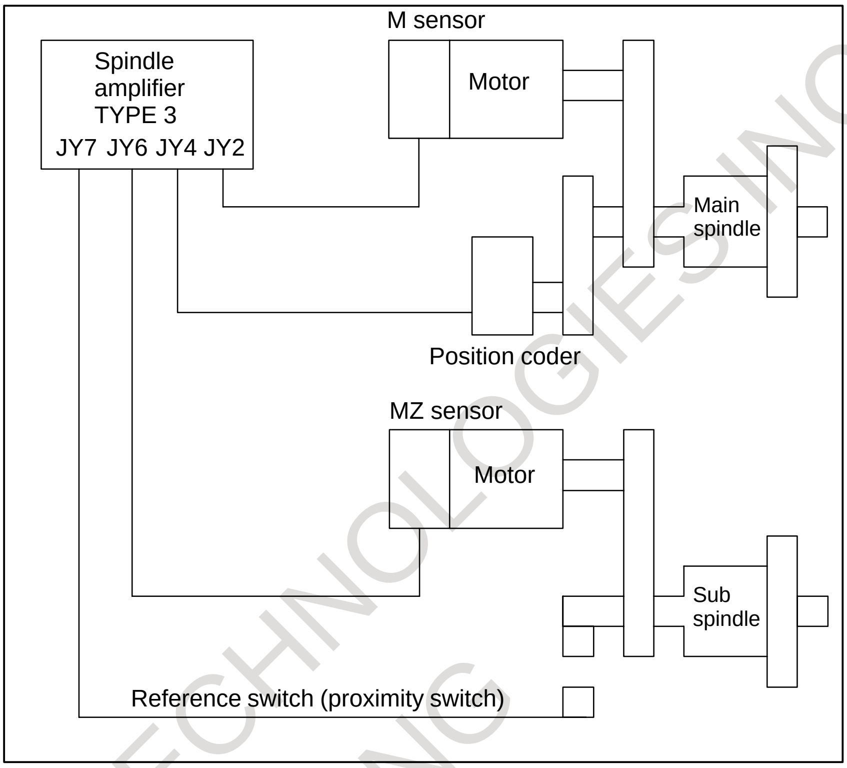
Detector	Connector
Built–in sensor on main spindle side (motor)	JY2
Pulse generator on subspindle side (motor)	JY6
Position coder on subspindle side (spindle)	JY8

2. Set the detector–related parameters. Set (b) above (for the main spindle side) before attempting the setting below.

Parameter	Setting	Description
4187 #2, 1, 0	Depends on the detector.	Sets a speed detector (for sub spindle side).
4179 #7, 6, 5, 4	0, 0, 0, 0	Sets a position coder signal (for sub spindle side).
4177 #2	1	Uses a position coder signal (for sub spindle side).

(j) When spindle switching control is performed, a M sensor and position coder are used on the main spindle side, and a motor's MZ sensor in a motor and a reference switch are used on the sub spindle side.

Example system configuration:



1. Connect the feedback signal cables.

Detector	Connector
M sensor for main spindle side (motor)	JY2
Position coder for main spindle side (spindle)	JY4
MZ sensor for sub spindle side (motor)	JY6
Reference switch signal for sub spindle side (spindle)	JY7

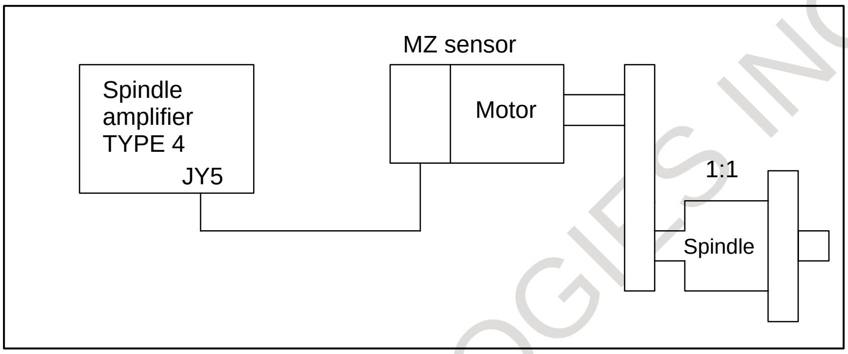
2. Set the detector–related parameters. Set (a) above (for the main spindle side) before attempting the setting below.

Parameter	Setting	Description
4179 #1	1	Uses a MZ sensor (for the sub spindle side).
4179 #7, 6, 5, 4	Depends on the detector.	Sets a position coder signal (for the sub spindle side).
4180 #4	Depends on the detector.	Sets the type of MZ sensor (for the sub spindle side).
4187 #2, 1, 0	Depends on the detector.	Sets a speed detector (for the sub spindle side).
4177 #2	1	Uses a position coder signal (for the sub spindle side).
4180 #2	1	Uses a external one rotation signal (for the sub spindle side).
4180 #3	1	Sets the reverse/unreverse for a external one rotation signal (for the sub spindle side).

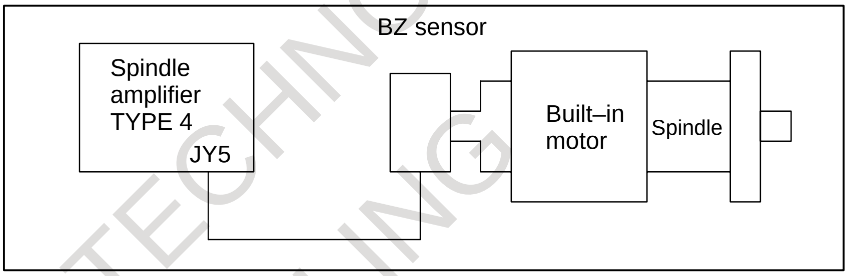
(4) Setting procedure when using the α sensor CS contouring control function

(a) If the spindle is connected to a built–in motor or a motor incorporating an MZ sensor at a ratio of 1:1

Example system configuration 1:



Example system configuration 2:



1. Connect the feedback signal cables.

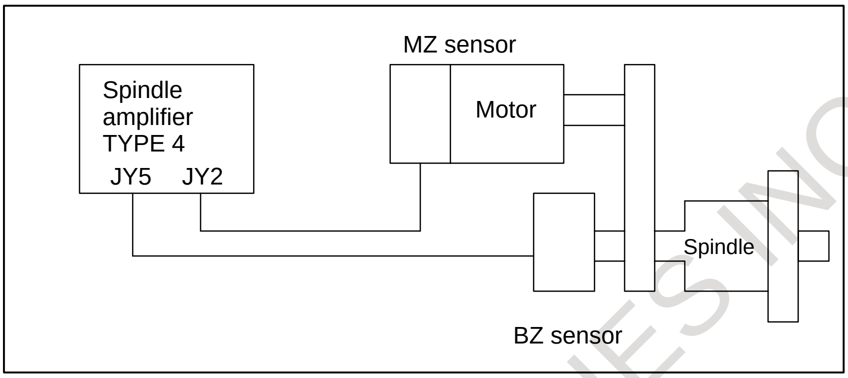
Detector	Connector
MZ sensor, BZ sensor (motor)	JY5

2. Set the detector–related parameters.

Parameter	Setting	Description
4018#4	1	Uses the α sensor Cs contouring control function.
4001#2	1	Uses a position coder signal.
4001#5	0	Does not use a high–resolution magnetic pulse coder.
4001#6	1	Uses a position detection signal for Cs contouring control also for speed detection.
4003#1	1	Uses an MZ sensor or BZ sensor.
4003#7,6,5,4	Depends on the detector.	Sets a position coder signal.
4004#1	0	Does not use a separate position detector.
4004#4	0	Sets a one–rotation signal type.
4011#2,1,0	Depends on the detector.	Sets a speed detector type.

(b) If an MZ sensor is used on the motor–side with a separate BZ sensor on the spindle side

Example system configuration:



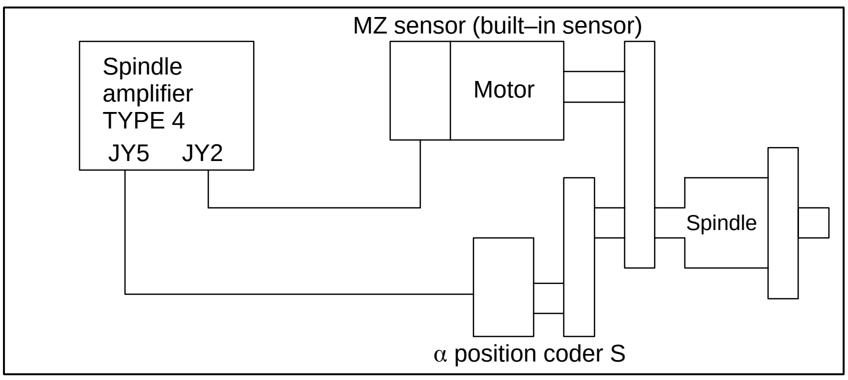
1. Connect the feedback signal cables.

Detector	Connector
MZ sensor (motor)	JY2
BZ sensor (spindle)	JY5

2. Set the detector–related parameters.

Parameter	Setting	Description
4018#4	1	Uses the α sensor Cs contouring control function.
4001#2	1	Uses a position coder signal.
4001#5	0	Does not use a high–resolution magnetic pulse coder.
4001#6	0	Specifies that a position detection signal for Cs contouring control is not used for speed detection.
4003#1	1	Uses an MZ sensor or BZ sensor.
4003#7,6,5,4	Depends on the detector.	Sets a position coder signal.
4004#1	1	Uses a separate position detector.
4004#4	0	Sets a one–rotation signal type.
4011#2,1,0	Depends on the detector.	Sets a speed detector type.

(c) If an MZ sensor is used on the motor–side with the α position coder S on the spindle side
Example system configuration:



1. Connect the feedback signal cables.

Detector	Connector
MZ sensor (motor)	JY2
α position coder S (spindle)	JY5

2. Set the detector–related parameters.

Parameter	Setting	Description
4018#4	1	Uses the α sensor Cs contouring control function.
4001#2	1	Uses a position coder signal.
4001#5	0	Does not use a high–resolution magnetic pulse coder.
4001#6	0	Specifies that a position detection signal for Cs contouring control is not used for speed detection.
4003#1	1	Uses an MZ sensor or BZ sensor.
4003#7,6,5,4	1,0,0,1	Sets a position coder signal.
4004#1	1	Uses a separate position detector.
4004#4	1	Sets a one–rotation signal type.
4011#2,1,0	Depends on the detector.	Sets a speed detector type.

1.2.5 Parameters Related to Normal Operation Mode

(1) Parameters related to normal operation mode

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st	2nd	1st	2nd			
6540	6680	3040	3180	3040	4040	Velocity loop proportional gain for normal operation (HIGH) CTH1A=0
6541	6681	3041	3181	3041	4041	Velocity loop proportional gain for normal operation (LOW) CTH1A=1
6548	6688	3048	3188	3048	4048	Velocity loop integral gain for normal operation (HIGH) CTH1A=0
6549	6689	3049	3189	3049	4049	Velocity loop integral gain for normal operation (LOW) CTH1A=1
6582	6722	3082	3222	3082	4082	Setting the acceleration/deceleration progress time
6583	6723	3083	3223	3083	4083	Motor voltage setting for normal rotation
6900	6940	3280	3500	3136	4136	Motor voltage setting for normal rotation (for low–speed characteristics in speed range switching control)

(2) Details of parameters related to normal operation mode

	0	15	15*i*	16*i*/16	
1st– 2nd–	6540 6680	3040 3180	3040	4040	Velocity loop proportion gain on normal operation (HIGH gear) CTHIA=0
1st– 2nd–	6541 6681	3041 3181	3041	4041	Velocity loop proportion gain on normal operation (LOW gear) CTHIA=1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This data is used to set the velocity loop proportion gain on normal operation.

A parameter is selected with the CTH1A input signal.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6548 6688	3048 3188	3048	4048	Velocity loop integral gain on normal operation (HIGH gear) CTHIA=0
1st– 2nd–	6549 6689	3049 3189	3049	4049	Velocity loop integral gain on normal operation (LOW gear) CTHIA=1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This data is used to set the velocity loop integral gain on normal operation.

A parameter is selected with the CTH1A input signal.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6583 6723	3083 3223	3083	4083	Motor voltage setting on normal rotation
1st– 2nd–	6900 6940	3280 3500	3136	4136	Motor voltage setting on normal rotation (for low–speed characteristics in speed range switching control)

Data unit : 1%

Data range : 0 to 100

Standard setting : Depends on the motor model.

This parameter is used to set a motor voltage in normal operation. The motor voltage to be set depends the motor model, the most usual setting is 30.

1.3 PARAMETER ADJUSTMENT

If the spindle motor malfunctions, correct the fault as specified in the table below. Refer to the maintenance manual for an explanation of the response required when an alarm occurs.

	Symptom	Relevant section
1	The motor does not rotate.	1.3.1
2	The motor does not rotate at the commanded speed.	1.3.2
3	The motor vibrates and generates noise while rotating.	1.3.3
4	Overshoot or hunting occurs.	1.3.4
5	The cutting capability is sub–standard.	1.3.5
6	The time required for acceleration/deceleration is increased.	1.3.6
7	An LED indicates a status error. (Status error indication function)	1.3.7

1.3.1 When the Motor Does Not Rotate

(1) Check all connections. (Refer to the description of the connections.)
- (a) Motor power line phase sequence
- (b) Feedback signal cable connection
- (c) DC link connection between the power supply module and amplifier module

(2) Check the parameter settings.
- (a) Parameter data for each motor model (See Appendix C.)
- (b) Detector–related parameters (See Section 1.2.4.)
- (c) Setting of maximum motor speed

0	15	15*i*	16*i*/16	Description
6520	3020	3020	4020	Maximum motor speed

- (d) Parameters related to spindle speed commands (See Section 1.2.3.)

(3) Check the Input signals.
- (a) Input signals for spindle control.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
G229	G227	G227	G070	MRDYA		SFRA	SRVA				
G230	G226	G226	G071							*ESPA	

(4) Check the feedback signals.
- (a) Feedback signal levels (Refer to the description of the operation check in the maintenance manual.)
- (b) Shielding and grounding (Refer to the description of the connections.)

1.3.2 When the Motor Does Not Rotate at the Commanded Speed

(1) Check all connections. (See the description of the connections.)

(a) Motor power line connection
(b) Feedback signal cable connection

(2) Check the parameter settings.

(a) Parameter data for each motor model (See Appendix C.)
(b) Detector–related parameters (See Section 1.2.4.)
(c) Setting of maximum motor speed

0	15	15*i*	16*i*/16	Description
6520	3020	3020	4020	Maximum motor speed

(d) Parameters related to spindle speed commands (See Section 1.2.3.)

(3) Check the feedback signals.

(a) Feedback signal levels (Refer to the description of the operation check in the maintenance manual.)
(b) Shielding and grounding (Refer to the description of the connections.)

1.3.3 When the Motor Vibrates and Generates Noise while Rotating

(1) Check the feedback signals.

(a) Feedback signal levels (Refer to the description of the operation check in the maintenance manual.)
(b) Shielding and grounding (Refer to the description of the connections.)

(2) Check the parameter settings.

(a) The velocity loop gain value may be too large. Adjust the parameters indicated below.

<table>
<tr><th>0</th><th>15</th><th>15i</th><th>16i/16</th><th>Description</th><th>Settings</th></tr>
<tr><td>6540</td><td>3040</td><td>3040</td><td>4040</td><td>Velocity loop proportional gain (HIGH)</td><td rowspan="2">Specify a smaller value.</td></tr>
<tr><td>6541</td><td>3041</td><td>3041</td><td>4041</td><td>Velocity loop proportional gain (LOW)</td></tr>
</table>

(b) In a high–speed rotation area, a speed variation of several Hz (3 Hz to 5 Hz) can occur because of a high motor voltage during rotation under no load.
Such a vibration can be eliminated by changing the motor voltage pattern under no load. Change the parameters indicated below.

0	15	15*i*	16*i*/16	Description	Settings
6507 #7	3007 #7	3007 #7	4007 #7	Motor voltage pattern under no load	1

(3) Compare the conditions when the motor is driven and when the motor is coasting.

If considerably less vibration and noise is observed while the motor is coasting, the control circuitry is faulty. If the same degree of vibration and noise is observed, however, the motor or machine is faulty.

The motor starts coasting and an alarm is issued if the feedback signal cable is disconnected while the motor is rotating. Before attempting to coast the motor, check with the machine tool builder. The machine can stop, depending on the sequence.

1.3.4 When Overshoot or Hunting Occurs

(1) Check the parameter settings.

(a) The velocity loop gain value may be too large. Adjust the parameters indicated below.

0	15	15*i*	16*i*/16	Description	Settings
6540	3040	3040	4040	Velocity loop proportional gain (HIGH)	Specify a smaller value.
6541	3041	3041	4041	Velocity loop proportional gain (LOW)	

1.3.5 When the Cutting Capability is Degraded

(1) Check the parameter settings.

(a) Parameter data for each motor (See Appendix C.)

(b) Limited output pattern and output limit

0	15	15*i*	16*i*/16	Description
6528	3028	3028	4028	Sets a limited output pattern.
6529	3029	3029	4029	Output limit

(2) Check the input signals.

(a) Torque limit command (TLMH, TLML)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
G229	G227	G227	G070							TLMHA	TLMLA

(3) Check the machine.

(a) Belt tension, etc.

1.3.6 When Time Required for Acceleration/ Deceleration Increases

(1) Check the parameter settings.

(a) Parameter data for each motor model (See Appendix C.)

(b) Limited output pattern and output limit

0	15	15*i*	16*i*/16	Description
6528	3028	3028	4028	Sets a limited output pattern.
6529	3029	3029	4029	Output limit

(c) Regenerative power limit (Make sure that the set value is the same as the one listed in the motor model–specific parameter table.)

0	15	15*i*	16*i*/16	Description
6580	3080	3080	4080	Regenerative power limit
6930	3310	3166	4166	Regenerative power limit (for low–speed characteristics)

(2) Check the input signals.

(a) Torque limit command (TLMH, TLML)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
G229	G227	G227	G070							TLMHA	TLMLA

1.3.7 Status Error Indication Function

If a parameter is set incorrectly, or an incorrect sequence is set, the error LED (yellow) of the indicator section on the spindle amplifier module (SPM) lights to indicate the corresponding error number.

If the spindle motor malfunctions, check the error number indication on the amplifier indicator section, then take correct the fault as described in the table below. Note that no status error number is displayed on the CNC screen.

Indication	Status error	Action
01	SFR (normal rotation command), SRV (reverse rotation command), or ORCM (orientation command) is entered when *ESP (emergency stop signal, which may be a input signal or contact signal) and MRDY (machine ready signal) are not applied.	Check the sequence of *ESP and MRDY. For MRDY, check bit 0 of parameter No. 4001, specifying whether to use the MRDY signal.
02	When the spindle and spindle motor are specified separately (with bit 5 of parameter No. 4001 set to 1, and bit 6 of parameter No. 4001 set to 0) in a system employing a high–resolution magnetic pulse coder, 128 /rev must be set for the motor speed detector (bits 2, 1, and 0 of parameter No. 4011 must be set to 0, 0, and 1, respectively). However, a value other than 128 /rev is set. In such a case, the motor is not activated.	Check the parameter settings.
03	The Cs contouring control command is input although bit 5 of parameter No. 4001 is set to 0 to specify that a high–resolution magnetic pulse coder is not used or although bit 4 of parameter No. 4018 is set to 0 to specify that the α sensor Cs contouring control function is not used. In such a case, The motor is not activated.	Check the parameter settings.
04	When bit 2 of parameter No. 4001 is set to 0 to specify that a position coder signal is not used, a command for servo mode control (rigid tapping, Cs axis control, etc.) or spindle synchronization control is entered. In such a case, the motor is not activated.	Check the parameter setting enabling the use of a position coder signal.
05	When the option parameter of the orientation function is not set, ORCM (orientation command) is entered.	Check the parameter setting enabling the use of the orientation function.
06	When the option parameter of the speed range switching control function is not set, winding for low–speed characteristics is selected (with RCH = 1).	Check the setting of the parameter for using the speed range switching control function, and the power line status check signal (RCH).
07	When the Cs contouring control command is entered, neither SFR (normal rotation command) nor SRV (reverse rotation command) is entered.	Check the sequence.
08	When a servo mode control command (rigid tapping, Cs axis control, etc.) is entered, neither SFR (normal rotation command) nor SRV (reverse rotation command) is entered.	Check the sequence.
09	When the spindle synchronization control command is entered, neither SFR (normal rotation command) nor SRV (reverse rotation command) is entered.	Check the sequence.
10	When the Cs contouring control command is entered, a another mode (such as the servo mode, spindle synchronous control, and orientation) is specified.	When Cs contouring control is specified, do not specify another mode. To enter another mode, first cancel the Cs contouring control command.
11	When a servo mode control command (rigid tapping, Cs axis control, etc.) is entered, another mode (such as Cs contouring control, spindle synchronization control, and orientation) is specified.	When a servo mode is specified, do not specify another mode. To enter another mode, first cancel the servo mode command.
12	When the spindle synchronization control command is entered, another mode (Cs contouring control, servo mode, or orientation) is specified.	When spindle synchronization control is specified, do not specify another mode. To enter another mode, first cancel the spindle synchronization control command.

Indication	Status error	Action
13	When the orientation command is entered, another mode (Cs contouring control, servo mode, or spindle synchronization control) is specified.	When orientation is specified, do not specify another mode. To enter another mode, first cancel the orientation command.
14	SFR (normal rotation command) and SRV (reverse rotation command) are entered at the same time.	Specify only SFR or SRV at one time.
15	When bit 5 of parameter No. 4000 is set to 1 to specify the use of the differential speed control function, the Cs contouring control command is entered.	Check the parameter setting and input signal.
16	When bit 5 of parameter No. 4000 is set to 0 to specify that the differential speed control function is not used, DEFMD (differential speed mode command) is entered.	Check the parameter setting and the differential speed mode command.
17	The setting of bits 2, 1, and 0 of parameter No. 4011 for specifying a speed detector is incorrect. The specified speed detector cannot be found.	Check the parameter setting.
18	When bit 2 of parameter No. 4001 is set to 0 to specify that a position coder signal is not used, orientation by a position coder is specified.	Check the parameter setting and input signal.
19	When orientation by a magnetic sensor is specified, another mode (Cs contouring control, servo mode, or spindle synchronization control) is specified.	When orientation is specified, do not specify another mode. To enter another mode, first cancel the orientation command.
20	When bit 5 of parameter No. 4014 is set to 1 to specify use of the slave operation function, bit 5 of parameter No. 4001 is set to 1 to specify use of a high–resolution magnetic pulse coder.	The use of the slave operation function and that of a high–resolution magnetic pulse coder cannot be specified at the same time. Check the parameters settings.
21	In a position control mode (servo mode, orientation, etc.), SLV (slave operation command) is entered.	Enter the slave operation command in normal operation mode only.
22	In slave operation mode, a position control command (servo mode, orientation, etc.) is entered.	Enter a position control command in normal operation mode only.
23	When bit 5 of parameter No. 4014 is set to 0 to specify that the slave operation function is not used, SLV (slave operation command) is entered.	Check the parameter setting.
24	In continuous indexing with orientation by a position coder, incremental operation (INCMD = 1) is first performed, after which the absolute position command (INCMD = 0) is entered.	Check INCMD (incremental command). Before specifying absolute position commands in succession, perform absolute position command orientation.
25	Bit 4 of parameter No. 4018 is set to 1 to enable the α sensor Cs contouring control function although SPM TYPE 4 is not selected.	Check the parameter setting and SPM drawing number.

2 FUNCTION EXPLANATION

2.1 POSITION CODER METHOD SPINDLE ORIENTATION

2.1.1 Start–up Procedure

A. Check that normal operation can be performed.

↓

B. Prepare and check the ladder program for spindle orientation.
(Refer to the descriptions.)

↓

C. Set the parameters related to spindle orientation.
(See Section 2.1.3.)

↓

D. Check the position coder signal.

↓

E. Check whether orientation is performed.

NG → return to B.

OK ↓

F. Set and check the direction used for orientation.
- Set the direction of rotation used for orientation.

↓

G. Adjust the orientation stop position.
- Detection level for the orientation completion signal
- Orientation stop position shift
- Orientation stop position
- Command multiplication by an externally set incremental command

↓

H. Adjust the orientation speed.
- Position gain for orientation
- Motor speed limit ratio for orientation
- Orientation speed

↓

I. Adjust the deceleration constant for shortest–time orientation.
- Orientation deceleration constant

↓

J. Adjust the orientation stop
(to eliminate overshoot and ensure stop–time rigidity).
- Position gain for orientation
- Velocity loop proportional gain for orientation
- Velocity loop integral gain for orientation
- Motor voltage for orientation
- Rate of change in position gain upon orientation completion
- Motor activation delay for orientation

↓

K. Check ATC operation.

2.1.2 DI/DO Signals Related to Position Coder Method Spindle Orientation

(1) Input signals (PMC→CNC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	G110 G112	G231 G239	G230 G238	G078 G080	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
1st– 2nd–	G111 G113	G230 G238	G231 G239	G079 G081					SHA11	SHA10	SHA09	SHA08
1st– 2nd–	G229 G233	G227 G235	G227 G235	G070 G074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
1st– 2nd–	G230 G234	G266 G234	G226 G234	G071 G075	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
1st– 2nd–	G231 G235	G229 G237	G229 G237	G072 G076	RCHHGA	MFNHGA	INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA

(2) Output signals (CNC→PMC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	F281 F285	F229 F245	F229 F245	F045 F049	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
1st– 2nd–	F282 F286	F228 F244	F228 F244	F046 F050					RCFNA	RCHPA	CFINA	CHPA

2.1.3 Parameters Related to Position Coder Method Spindle Orientation

Parameter No.				Description
0	15	15*i*	16*i*/16	
6515 #0	3015 #0	3015 #0	4015 #0	Specifies whether to use the spindle orientation function. (Set this bit to 1.) (The CNC software option is required.)
0080 #3, #2	5609 #3, #2	5609 #2	3702 #3, #2	Specifies whether to use the spindle orientation function with the stop position set externally. (Bit 2: 1st spindle, Bit 3: 2nd spindle)
6501 #2	3001 #2	3001 #2	4001 #2	Specifies whether to use a position coder signal. (Set this bit to 1.)
6500 #2	3000 #2	3000 #2	4000 #2	Position coder mounting direction
6500 #0	3000 #0	3000 #0	4000 #0	Direction of spindle and motor rotation
6503 #0	3003 #0	3003 #0	4003 #0	Selects whether spindle orientation is done using a position coder or with a magnetic sensor. (Set this bit to 0 to select spindle orientation by a position coder.)
6503 #3, 2	3003 #3, 2	3003 #3, 2	4003 #3, 2	Direction of rotation in spindle orientation
6503 #7, 6, 5, 4	3003 #7, 6, 5, 4	3003 #7, 6, 5, 4	4003 #7, 6, 5, 4	Sets a position coder signal.
6517 #2	3017 #2	3017 #2	4017 #2	Function for detecting a position coder one–rotation signal during normal rotation
6517 #7	3017 #7	3017 #7	4017 #7	Shortcut function when orientation is specified in stop state
6531	3031	3031	4031	Stop position for position coder method orientation (This parameter is disabled when spindle orientation with an externally set stop position or an externally set incremental command is used.)
6542 6543	3042 3043	3042 3043	4042 4043	Velocity loop proportional gain for orientation (A parameter is selected by the CTH1A input signal.)
6550 6551	3050 3051	3050 3051	4050 4051	Velocity loop integral gain for orientation (A parameter is selected by the CTH1A input signal.)
6556 to 6559	3056 to 3059	3056 to 3059	4056 to 4059	Spindle–to–motor gear ratio (A parameter is selected by the CTH1A and CTH2A input signals.)
6560 6563	3060 to 3063	3060 to 3063	4060 to 4063	Position gain for orientation (A parameter is selected by the CTH1A and CTH2A input signals.)
6564	3064	3064	4064	Rate of change in the position gain upon completion of spindle orientation
6575	3075	3075	4075	Detection level for the spindle orientation completion signal
6576	3076	3076	4076	Motor speed limit ratio for spindle orientation
6577	3077	3077	4077	Spindle orientation stop position shift
6584	3084	3084	4084	Motor voltage for spindle orientation
6598	3098	3098	4098	Maximum speed for position coder signal detection
6276	3456	3312	4312	Detection level for the orientation approach signal for a position coder
6284 to 6287	3464 to 3467	3320 to 3323	4320 to 4323	Shortest–time orientation deceleration constant (A parameter is selected by the CTH1A and CTH2A input signals.)
6290	3470	3326	4326	Pulse width for shortest–time orientation control mode switching

Parameter No.				Description
0	15	15*i*	16*i*/16	
6292	3472	3328	4328	Command multiplication with an externally set incremental command
6294	3474	3330	4330	Motor activation delay for spindle orientation
6509 #3	3009 #3	3009 #3	4009 #3	Arbitrary gear ratio function for orientation with a reference switch
6504 #2	3004 #2	3004 #2	4004 #2	Specifies whether to use a reference switch signal.
6504 #3	3004 #3	3004 #3	4004 #3	Specifies the detection edge of a reference switch signal.
6538	3038	3038	4038	Spindle orientation speed
6935 6937	3315 3317	3171 3173	4171 4173	Number of spindle gear teeth for orientation with a reference switch (A parameter is selected by the CTH1A DI signal.)
6936 6938	3316 3318	3172 3174	4172 4174	Number of position detector gear teeth for orientation with a reference switch (A parameter is selected by the CTH1A DI signal.)

Parameters on the Sub spindle Side for Spindle Switching Control

Parameter No.				Description
0	15	15*i*	16*i*/16	
6141 #2	33321 #2	3177 #2	4177 #2	Specifies whether to use a position coder signal. (Set this bit to 1.)
6140 #2	3320 #2	3176 #2	4176 #2	Position coder mounting direction
6140 #0	3320 #0	3176 #0	4176 #0	Direction of spindle and motor rotation
6143 #0	3323 #0	3179 #0	4179 #0	Selects position coder method or magnetic sensor method spindle orientation (Set this bit to 0 to select position coder method.)
6143 #3, 2	3323 #3, 2	3179 #3, #2	4179 #3, 2	Direction of rotation in spindle orientation
6143 #7, 6, 5, 4	3323 #7, 6, 5, 4	3179 #7, 6, 5, 4	4179 #7, 6, 5, 4	Sets the position coder signal.
6157 #2	3337 #2	3193 #2	4193 #2	Function for detecting a position coder one–rotation signal during normal rotation
6157 #7	3337 #7	3193 #7	4193 #7	Shortcut function when orientation is specified in stop state
6168	3348	3204	4204	Stop position in position coder method orientation (This parameter is disabled when spindle orientation with an externally set stop position or externally set incremental command is used.)
6172 6173	3352 3353	3208 3209	4208 4209	Velocity loop proportional gain for orientation (A parameter is selected by the CTH1A input signal.)
6177	3357	3213	4213	Velocity loop integral gain for orientation
6180 6181	3360 3361	3216 3217	4216 4217	Spindle–to–motor gear ratio (A parameter is selected by the CTH1A input signal.)
6182 6183	3362 3363	3218 3219	4218 4219	Position gain for orientation (A parameter is selected by the CTH1A input signal.)
6184	3364	3220	4220	Rate of change in the position gain upon the completion of spindle orientation
6190	3370	3226	4226	Detection level for the spindle orientation completion signal
6191	3371	3227	4227	Motor speed limit ratio for spindle orientation
6192	3372	3228	4228	Spindle orientation stop position shift
6201	3381	3237	4237	Motor voltage for spindle orientation
6280	3460	3316	4316	Detection level for the approach signal for orientation by a position coder

Parameter No.				Description
0	**15**	**15*i***	**16*i*/16**	
6288 6289	3468 3469	3324 3325	4324 4325	Shortest–time orientation deceleration constant (A parameter is selected by the CTH1A input signal.)
6291	3471	3327	4327	Pulse width for shortest–time orientation control mode switching
6293	3473	3329	4329	Command multiplication with an externally set incremental command
6295	3475	3331	4331	Motor activation delay for spindle orientation
6149 #3	3329 #3	3185 #3	4185 #3	Arbitrary gear ratio function for orientation with a reference switch
6144 #2	3324 #2	3180 #2	4180 #2	Specifies whether to use a external one rotation signal
6144 #3	3324 #3	3180 #3	4180 #3	Specifies the reverse/unreverse of a external one rotation signal
6169	3349	3205	4205	Spindle orientation speed
6207 6209	3387 3389	3243 3245	4243 4245	Number of spindle gear teeth for orientation with a reference switch (A parameter is selected by the CTH1A input signal.)
6208 6210	3388 3390	3244 3246	4244 4246	Number of position detector gear teeth used for orientation with a reference switch (A parameter is selected by the CTH1A input signal.)

2.1.4 Detail of Parameter for Position Coder System Spindle Orientation.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6500	3000	3000	4000						POSC1		ROTA1
2nd–	6640	3140										

ROTA1: Indicates the relationship between the rotation directions of spindle and spindle motor.

0: Rotates the spindle and spindle motor in the same direction.

1: Rotates the spindle and spindle motor in the reverse direction.

POSC1: Indicates the mounting direction of position coder.

0: Rotates the spindle and position coder in the same direction.

1: Rotates the spindle and position coder in the reverse direction.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6501	3001	3001	4001						POSC2		
2nd–	6641	3141										

POSC2: Determines whether the POSITION CODER signal is used or not.

Set to ”1”: Used.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6503	3003	3003	4003	PCPL2	PCPL1	PCPL0	PCTYPE	DIRCT2	DIRCT1		PCMGSL
2nd–	6643	3143										

DIRCT2-DIRCT1:

Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before (It is CCW at the power on.)
0	1	By rotation direction immediately before (It is CW at the power on.)
1	0	CCW (counterclockwise) direction looking from shaft of motor
1	1	CW (clockwise) direction looking from shaft of motor

When ”By rotation direction immediately before” is set, ”rotation direction immediately before” is determined to be the direction of rotation performed at a level higher than the zero speed detection level (Output signal SST = 0).

PCMGSL:

Selects the type of orientation.

Set this bit to 0 (orientation by a position coder).

PCPL2, PCPL1, PCPL0, PCTYPE:

Set a position coder signal.

Set these bits according to the type of detector being used. Set these bits to ”0,0,0,0” when using a position coder.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6504	3004	3004	4004					RFTYPE	EXTRF		
2nd–	6644	3144										

EXTRF: Specifies whether an external one–rotation signal is used.

0: Not used.

1: Used.

RFTYPE: Specifies whether to invert the external one–turn signal.

0: The final signal is to be inverted.

1: The final signal is not to be inverted.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6509	3009	3009	4009					PCGEAR			
2nd–	6649	3149										

PCGEAR:

Setting of the spindle orientation with a reference switch. To enable use of the reference switch signal, set this bit to 1.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6517	3017	3017	4017	NRROEN					RFCHK4		
2nd–	6657	3157										
Standard setting:					0	0	0	0	0	0	0	0

RFCHK4:

Specifies whether to use the position coder 1- rotation signal detection function in normal rotation.

0: Does not detect the 1-rotation signal in normal rotation.

1: Detects the 1-rotation signal in normal rotation.

Setting this bit to 1 reduces the time required for orientation by a position coder immediately after the spindle speed exceeds the maximum position coder signal detection speed (set in parameter No. 4098).

NRROEN:

Specifies whether to use the shortcut function when orientation is specified in the stop state.

0: Does not use the function.

1: Uses the function.

When this bit is set to 1, short cut operation is performed when the following conditions are satisfied:

- Bit 7 of parameter No. 4016 (RFCHK3) is set to 0.
- Zero speed detection output signal SST is set to 1.
- Shortcut command input signal NRROA is set to 1.

0	15	15*i*	16*i*/16	
6531 6671	3031 3171	3001	4031	Position coder method orientation stop position

Data unit : 1 pulse (360_/4096)

Data range : 0 to 4096

Standard setting : 0

This data is used to set the stop position of position coder method spindle orientation.
It can be set at every 360 degrees/4096.
When stop position external command type orientation and incremental command external type orientation are set, this parameter becomes invalid.
Stop position command (SHA11–SHA00) of input signal instructed becomes valid.

0	15	15*i*	16*i*/16	
6538 6678	3038 3178	3038	4038	Spindle orientation speed

Data unit : 1 min^{-1} (10 min^{-1} when bit 2 of parameter No. 4006 (SPDUNT) is set to 1)

Data range : 0 to 32767

Standard setting : 0

This parameter sets the orientation speed at the end of the spindle.
A constant orientation speed is maintained at the end of the spindle to ensure reliable detection of the reference switch signal, even when a gear change is made.
When the spindle orientation function with a reference switch is to be used, set this parameter.
When 0 is specified for this parameter, the orientation speed is determined depending on the position gain and the motor speed limit ratio for orientation.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6542 6682	3042 3182	3042	4042	Velocity loop proportion gain on orientation (HIGH gear) CTH1A=0
1st– 2nd–	6543 6683	3043 3183	3043	4043	Velocity loop proportion gain on orientation (LOW gear) CTH1A=1

Data unit :
Data range : 0 to 32767
Standard setting : 10

This parameter sets the velocity loop proportional gain for spindle orientation.
When the CTH1A input signal is set to 0, proportional gain for the HIGH gear is selected. When the CTH1A input signal is set to 1, proportional gain for the LOW gear is selected.
Using these parameters, the response during orientation deceleration, as well as rigidity in the orientation stop state, can be adjusted.
Set the maximum allowable values that do not cause vibration in the orientation stop state.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6550 6690	3050 3190	3050	4050	Velocity loop integral gain on orientation (HIGH gear) CTH1A=0
1st– 2nd–	6551 6691	3051 3191	3051	4051	Velocity loop integral gain on orientation (LOW gear) CTH1A=1

Data unit :
Data range : 0 to 32767
Standard setting : 10

When the CTH1A input signal is set to 0, integral gain for the HIGH gear is selected. When the CTH1A input signal is set to 1, integral gain for the LOW gear is selected.
Rigidity in the orientation stop state is adjusted using these parameters.
To adjust the velocity loop integral gain, specify a value that is one to five times greater than the velocity loop proportional gain set in parameter No. 4042.

	0	15	15*i*	16*i*/16		
1st– 2nd–	6556 6696	3056 3196	3056	4056	Gear ratio (HIGH)	CTH1A=0, CTH2A=0
1st– 2nd–	6557 6697	3057 3197	3057	4057	Gear ratio (MEDIUM HIGH)	CTH1A=0, CTH2A=1
1st– 2nd–	6558 6698	3058 3198	3058	4058	Gear ratio (MEDIUM LOW)	CTH1A=1, CTH2A=0
1st– 2nd–	6559 6699	3059 3199	3059	4059	Gear ratio (LOW)	CTH1A=1, CTH2A=1

Data unit : Motor rotation for one rotation of spindle × 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation × 1000)
Data range : 0 to 32767
Standard setting : 100

These parameters set the gear ratio of the spindle motor relative to the spindle.
When the motor rotates 2.5 times, for every rotation of the spindle, for example, set 250 in the parameter.
A parameter is selected by the CTH1A and CTH2A input signals.
The gear or clutch status must correspond to the status of the CTH1A and CTH2A input signals.

	0	15	15*i*	16*i*/16		
1st– 2nd–	6560 6700	3060 3200	3060	4060	Position gain on orientation (HIGH)	CTH1A=0, CTH2A=0
1st– 2nd–	6561 6701	3061 3201	3061	4061	Position gain on orientation (MEDIUM HIGH)	CTH1A=0, CTH2A=1
1st– 2nd–	6562 6702	3062 3202	3062	4062	Position gain on orientation (MEDIUM LOW)	CTH1A=1, CTH2A=0
1st– 2nd–	6563 6703	3063 3203	3063	4063	Position gain on orientation (LOW)	CTH1A=1, CTH2A=1

Data unit : 0.01 sec^{-1}
Data range : 0 to 32767
Standard setting : 1000
These parameters set the position gain for orientation.
A parameter is selected by the CTH1A and CTH2A input signals.
See Section 2.1.5.
In shortest–time orientation, the position gain parameter is used upon the completion of orientation (ORARA = 1).
For shortest–time orientation, the position gain can be increased to up to a value obtained using the expression below. If vibration occurs in the stop state when the value obtained from the following expression is specified as the position gain, decrease the position gain.

$$\text{Setting} = \frac{(\text{deceleration constant in parameter No.4320}) \times 106}{(\text{mode switching pulse count in parameter No.4326})}$$

When parameter No. 4326 is set to 0, however, the mode switching pulse count will be 205.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6564 6704	3064 3204	3064	4064	Modification rate of position gain on orientation completion

Data unit : 1%
Data range : 0 to 1000
Standard setting : 100
This data is used to set the modification rate of position gain on spindle orientation completion.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6575 6715	3075 3215	3075	4075	Orientation completion signal detection level (limits of imposition)

Data unit : Position coder method → ± 1 pulse unit
Magnetic sensor method → ± 0.1 degree unit
Data range : 0 to 100

Standard setting : 10

This data is used to set the detecting level of orientation completion signal (ORARA).

When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORARA) in the spindle control signals is set to "1".

	0	15	15*i*	16*i*/16	
1st–	6576	3076	3076	4076	Motor speed limit value on orientation
2nd–	6716	3216			

Data unit : 1%

Data range : 0 to 100

Standard setting : 33

This data is used to set the motor speed limit value on orientation.

Orientation speed of motor [min^{-1}] = Position gain × Gear ratio × 60

Speed limit value [min^{-1}] = Orientation speed of motor × (Setting data)/100

	0	15	15*i*	16*i*/16	
1st–	6577	3077	3077	4077	Orientation stop position shift value
2nd–	6717	3217			

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.01 degree unit

Data range : Position coder method → – 4095 to 4095
Magnetic sensor method → – 100 to 100

Standard setting : 0

In the position coder method orientation, set this data to shift stop position.

Spindle is shift No. of setting pulse in CCW direction, and stops by data (+).

See 2.1.6.

	0	15	15*i*	16*i*/16	
1st–	6584	3084	3084	4084	Motor voltage setting on orientation
2nd–	6724	3224			

Data unit : 1%

Data range : 0 to 100

Standard setting : Depends on the motor model

This parameter sets the motor voltage for orientation. Usually, set 30. The value may vary, however, depending on the motor model.

	0	15	15*i*	16*i*/16	
1st–	6598	3098	3098	4098	Maximum speed of position coder signal detection
2nd–	6738	3238			

Data unit : 1min^{-1}

(When parameter No. 4006 #1 (GRUNIT) =1, 10min^{-1})

Data range : 0 to 32767

Standard setting : 0

Parameter for setting the maximum speed of position coder signal detections possible.
If the parameter is set to ”0”, the speed of detections possible is the same as the maximum speed (parameter No. 4020) for the motor

	0	15	15*i*	16*i*/16		
1st–	6935	3315	3171	4171	Number of spindle gear teeth (HIGH)	!CTH1A=0
2nd–	6975	3535				
1st–	6936	3316	3172	4172	Number of position detector gear teeth (HIGH)	!CTH1A=0
2nd–	6976	3536				
1st–	6937	3317	3173	4173	Number of spindle gear teeth (LOW)	!CTH1A=1
2nd–	6977	3537				
1st–	6938	3318	3174	4174	Number of position detector gear teeth (LOW)	!CTH1A=1
2nd–	6978	3538				

Data unit :

Data range : 0 to 32767

Standard setting : 0

These parameters set an arbitrary gear ratio between the spindle and position detector (position coder). These parameters are used when the function for spindle orientation with a reference switch is used (when bit 3 of parameter No. 4009 (PCGEAR) is set to 1).
When bit 3 of parameter No. 4009 (PCGEAR) is 1, this parameter is assumed to be 1 even if 0 is specified.
When the spindle gear has 27 teeth, and the gear for the motor with a built–in sensor has 54 teeth, for example, set the parameters as follows:

Parameter No. 4171 = 1 (27)

Parameter No. 4172 = 2 (54)

	0	15	15*i*	16*i*/16	
1st–	6276	3456	3312	4312	Detection level for the approach signal for position coder method orientation
2nd–	6456	3676			

Data unit : +1 pulse

Data range : 0 to 32767

Standard setting : 0

This parameter sets the detection level for the approach signal for position coder method orientation (POAR2). When the spindle is within the parameter–set range, orientation approach signal (POAR2) is set to 1.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6284 6464	3464 3684	3320	4320	Spindle orientation deceleration constant (HIGH) CTH1A=0, CTH2A=0
1st– 2nd–	6285 6465	3465 3685	3321	4321	Spindle orientation deceleration constant (MEDIUM HIGH) CTH1A=0, CTH2A=1
1st– 2nd–	6286 6466	3466 3686	3322	4322	Spindle orientation deceleration constant (MEDIUM LOW) CTH1A=1, CTH2A=0
1st– 2nd–	6287 6467	3467 3687	3323	4323	Spindle orientation deceleration constant (LOW) CTH1A=1, CTH2A=1

Data unit :
Data range : 0 to 32767
Standard setting : 0

These parameters set the deceleration constants for shortest–time spindle orientation.
When the parameter is set to 0, the normal orientation control method is used.
The value to be set can be calculated using the following expression:

$$\text{Setting} = \sqrt{\frac{Nb}{Tb} \times 120 \times \frac{GEAR}{GEARUNIT} \times (0.8 \text{ to } 0.9)}$$

where,

Nb : Spindle motor base speed [min^{-1}]

Tb : Time required for the spindle motor to accelerate from the stop state to the base speed [sec]

GEAR : Gear ratio parameter (parameter Nos. 4056 to 4059)

GEARUNIT : Increment system for the gear ratio parameters
When bit 1 of parameter No. 4006 (GRUNIT) is set to 0, GEARUNIT = 100

When bit 1 of parameter No. 4006 (GRUNIT) is 1, GEARUNIT = 1000

When the speed increment system is 10 min^{-1} (bit 2 of parameter No. 4006 is set to 1), a value equal to one–tenth of the value calculated from the above expression must be set.
For example, suppose the following:

Spindle motor base speed	Nb = 1500 min^{-1}
Time required for the spindle motor to accelerate from the stop state to the base speed	Tb = 1 sec
Gear ratio parameter value (Nos. 4056 to 4059)	Gear = 200
Increment system for the gear ratio parameter	GEARUNIT = 100

Then,

$$\text{Setting} = \sqrt{\frac{1500}{1} \times 120 \times \frac{200}{100} \times (0.8 \text{ to } 0.9)} = 480 \text{ to } 540$$

Since the base speed of the spindle motor is 1500 min^{-1} and the gear ratio is 1:2 in this example, spindle motor acceleration time Tb is the time needed to reach 750 min^{-1} from the stop state.

An approximate value for Nb/Tb can be calculated as follows:

$$\frac{Nb}{Tb} = \frac{Tm}{Jm + Jl} \times \frac{60}{2\pi}$$

where,
Tm : 30–min rated torque [Nm]
Jm + Jl : Rotor inertia + load inertia [kg m^2]

	0	15	15*i*	16*i*/16	
1st–	6290	3470	3326	4326	Spindle orientation control mode switching pulse width
2nd–	6470	3690			

Data unit : $\overline{\text{(number of control mode switching pulses)}} \times 64$

Data range : 0 to 32767

Standard setting : 0

This parameter sets the pulse width used for switching the orientation control mode when shortest–time spindle orientation is performed.
When 0 is set for this parameter, positioning by position gain is set when the positioning deviation is 205 pulses (5% of 4096 pulses) or less.
To perform orientation control mode switching when the positioning deviation is 256 pulses, for example, set the following value:

Setting = $\overline{256} \times 64 = 1024$

	0	15	15*i*	16*i*/16	
1st–	6292	3472	3328	4328	Command multiplier for spindle orientation using a position coder
2nd–	6472	3692			

Data unit :

Data range : 0 to 32767

Standard setting : 0

This parameter specifies command multiplier for the spindle orientation function for which incremental commands are specified externally.
When 0 is specified for this parameter, multiplication by one is set automatically.
When the spindle speed is to be controlled, set 4096 in this parameter.

	0	15	15*i*	16*i*/16	
1st–	6294	3474	3330	4330	Motor activation delay for spindle orientation
2nd–	6474	3694			

Data unit : 1 msec

Data range : 0 to 32767

Standard setting : 0

This parameter is valid only when the speed is within the range between the zero speed detection level (SST = 0) and the orientation speed in shortest–time orientation.
When 0 is specified for this parameter, 50 msec is set automatically.

When spindle orientation is started when the speed is within the range between the zero speed detection level and the orientation speed, overshoot may occur upon orientation stop. This may be prevented by specifying 50 msec or more in the parameter.

2.1.5 Calculating the Position Gain for Orientation

(1) When the spindle orientation speed (parameter No. 4038) is set to 0, the orientation speed is determined using the following expression:

$$\text{Nori} = 60 \times \text{PG} \times \text{Rori} \times \text{GEAR}$$

where,

- Nori : Orientation speed (motor speed) [min^{-1}]
- Rori : Motor speed limit ratio for orientation (parameter No. 4076)
- PG : Position gain for orientation [sec^{-1}] (parameter Nos. 4060 to 4063)
- GEAR : Spindle–to–motor gear ratio (Parameter Nos. 4056 to 4059)

(2) The position gain for spindle orientation is obtained using the following expression:

$$\text{PG} \leqq \sqrt{\frac{\text{Tm}}{2\pi \times (\text{Jm} + \text{Jl}) \times \text{Rori} \times \text{GEAR}}}$$

where,

- PG : Position gain for orientation [sec^{-1}] (parameter Nos. 4060 to 4063)
- Tm : 30–min rated torque [Nm] for the motor when rotating at Nori [min^{-1}]
- Jm : Rotor inertia [kg m^2]
- Jl : Load inertia converted to motor shaft inertia [kg m^2]
- Rori : Motor speed limit ratio for orientation (parameter No. 4076)
- GEAR : Spindle–to–motor gear ratio (parameter Nos. 4056 to 4059)

(3) Calculation example when motor model 6 is being used alone)

$$\text{Tm} = \frac{7500\ [\text{W}]}{1500\ [\text{min}^{-1}] \times 1.0269} = 4.86\ [\text{Nm}]$$

$$\text{Jm} = 0.0022\ [\text{kg m}^2]$$

$$\text{Rori} = 33\ [\%]$$

$$\therefore\ \text{PG} \leqq \sqrt{\frac{486}{2\pi \times 0.0022 \times 0.33}} = 32\ [\text{sec}^{-1}]$$

2.1.6 Adjusting the Orientation Stop Position Shift Parameter

Adjust the orientation stop position shift parameter by following the procedure below.

(1) Specify parameters as follows:
  Bit 7 of parameter No. 4016 = 0
  Parameter No. 4031 = 0
  (When external signals are used for setting, set the SHA11 to SHA00 DI signals to 0.)
  Parameter No. 4077 = 0

(2) To display the position coder counter under position control, set the following on the spindle check board:
  d–01 = 114
  d–02 = 0
  d–03 = 0
  d–04 = 0

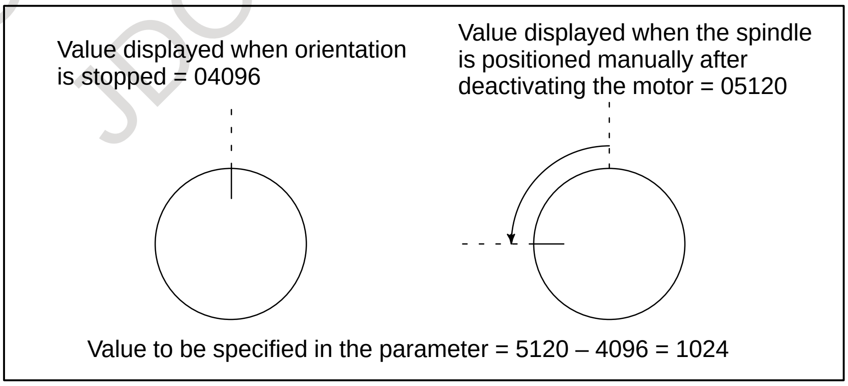
(3) Enter an orientation command (ORCMA) to stop orientation.

(4) Once orientation stops, check that 04096 or an integer multiple of 4096 (0, 4096, 8192, ...) is displayed.

(5) Release the orientation command to deactivate the motor.

(6) Manually position the spindle to the position where you want the spindle to stop. Then, read the displayed value.

(7) Obtain the difference between the value read in (6) and the value obtained in (4). Specify the obtained difference as the orientation stop position shift parameter.
  Setting = Value read in (6) – value read in (4)
  Example:



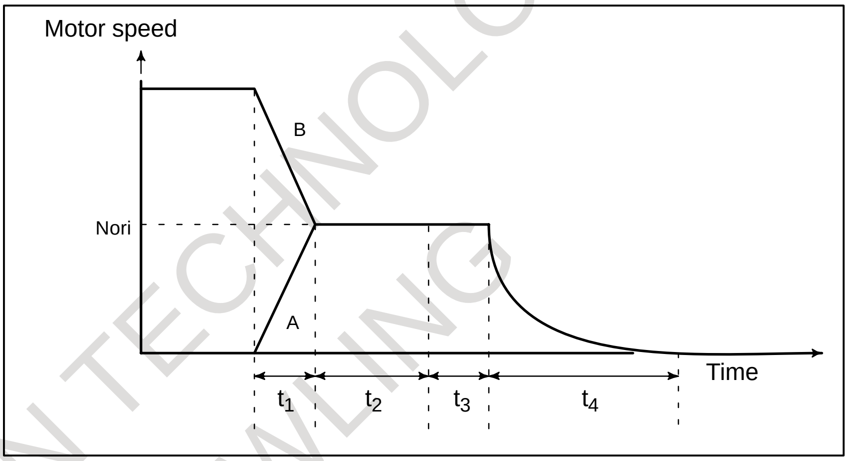
2.1.7 Calculating the Orientation Time

The time required for orientation differs between the first orientation (before the position coder one–rotation signal has first been detected) and the second and subsequent orientations (once the one–rotation signal has been detected).

(1) Before the one–rotation signal has first been detected (first orientation)

The time, from the input of an orientation command until orientation stops, is divided into four periods.

In the following figure, A indicates that the motor in the stop state starts rotating and is accelerated to the orientation speed. B indicates that the already rotating motor is decelerated to the orientation speed.



t_1 : Time required to achieve orientation speed Nori [sec]

t_2 : Time from the detection of a one–rotation signal (0 to 1 rotation) after Nori is achieved, until the number of pulses output before the next one–rotation signal has been checked [sec]

t_3 : Time from the completion of the checking of the number of pulses until deceleration starts [sec]

t_4 : Time from the start of deceleration until orientation is completed [sec]

(a) Normally, t_1 is measured on the actual machine.

Orientation speed Nori [min^{-1}] is calculated from position gain PG [sec^{-1}] and the motor speed limit ratio for orientation Rori.

$$Nori = PG \times 60 \times Rori$$

(b) t_2 is the time required for the motor to rotate one to two turns at orientation speed Nori [min^{-1}].

$$1 \times 60 \quad Nori \leqq t_2 \leqq 2 \times 60 \quad Nori$$

$$\therefore \ \frac{1}{PG \times Rori} \leqq t_2 \leqq \frac{2}{PG \times Rori}$$

(c) t_3 is the time required for the motor to rotate zero to one turns at orientation speed Nori [min^{-1}].

$$0 \times 60 \quad \text{Nori} \leqq t_3 \leqq 1 \times 60 \quad \text{Nori}$$

$$\therefore \quad 0 \leqq t_3 \leqq \frac{1}{PG \times Rori}$$

(d) t_4 is the time from the start of deceleration until orientation has been completed.

Let the orientation completion width be within +10 pulses. Then, t_4 can be calculated as follows:

$$t_4 = \frac{1}{PG} \times \ln \frac{4096 \times Rori}{10}$$

(e) Therefore, the orientation time t [sec] (= $t_1 + t_2 + t_3 + t_4$) can be expressed as follows:

$$t_1 + \frac{1}{PG \times Rori} + \frac{1}{PG} \ln \frac{4096 \times Rori}{10} \leqq t \leqq t_1 + \frac{3}{PG \times Rori} + \frac{1}{PG} \ln \frac{4096 \times Rori}{10}$$

(2) Once the one–rotation signal has been detected (second and subsequent orientations)

(a) Once the one–rotation signal has been detected, the time required to detect the signal is no longer necessary. Therefore, when orientation is started from the rotating state, orientation time t [sec] (= $t_1 + t_3 + t_4$) is expressed as follows:

$$t_1 + \frac{1}{PG} \ln \frac{4096 \times Rori}{10} \leqq t \leqq t_1 + \frac{1}{PG \times Rori} + \frac{1}{PG} \ln \frac{4096 \times Rori}{10}$$

(b) Whenever orientation is started from the stop state, orientation must be completed and the stop state entered within one rotation. In this case, the orientation time t [sec] is expressed as follows:

$$0 \leqq t \leqq \frac{1 - Rori}{PG \times Rori} + \frac{1}{PG} \ln \frac{4096 \times Rori}{10}$$

(3) Calculation examples

Time required to achieve the orientation speed $t_1 = 0.5$ [sec]

Position gain PG = 20 [sec^{-1}]

Motor speed limit for orientation Rori = 0.33 (= 33%)

(a) Orientation time before the one–rotation signal has been detected

$$0.5 + \frac{1}{20 \times 0.33} + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10} \leqq t \leqq 0.5 + \frac{3}{20 \times 0.33} + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10}$$

$$\therefore \quad 0.896 \text{ [sec]} \leqq t \leqq 1.196 \text{ [sec]}$$

(b) Orientation time when orientation is started from the rotating state (once the one–rotation signal has been detected)

$$0.5 + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10} \leqq t \leqq 0.5 + \frac{1}{20 \times 0.33} + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10}$$

$$\therefore \quad 0.746 \text{ [sec]} \leqq t \leqq 0.896 \text{ [sec]}$$

(c) Orientation time when orientation is started from the stop state (once the one–rotation signal has been detected)

$$0 \leqq t \leqq \frac{1 - 0.33}{20 \times 0.33} + \frac{1}{20} \times \ln \frac{4096 \times 0.33}{10}$$

$$\therefore \quad 0 \text{ [sec]} \leqq t \leqq 0.346 \text{ [sec]}$$

2.2 HIGH–SPEED ORIENTATION

2.2.1 Procedure for Setting Parameters

1) Specify bit parameters (including position coder setting).
2) Specify the orientation stop position.
   - No. 4077: Orientation stop position shift value
   - No. 4031: Orientation stop position
   - No. 4075: Orientation completion signal detection level
3) Specify a gear ratio.
   - Nos. 4056 to 4059: Gear ratio
4) Specify a motor deceleration time constant.
   - Nos. 4320 to 4323: Motor deceleration time constant
5) Specify a proportional gain and integral gain of velocity loop and a position gain.
   - Nos. 4042, 4043: Velocity loop proportional gain on orientation
   - Nos. 4050, 4051: Velocity loop integral gain on orientation
   - Nos. 4060 to 4063: Position gain on orientation
6) Specify the following parameters as needed:
   - No. 4018, #5: Velocity command correction at high–speed orientation
   - No. 4038: Upper limit of spindle orientation speed
   - No. 4064: Deceleration time constant restriction ratio
   - No. 4084: Motor voltage setting on orientation
   - Nos. 4326, 4330: Deceleration time constant restriction start velocity

2.2.2 Spindle Control Signals

(1) Input signals (PMC→CNC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	G110 G112	G231 G239	G230 G238	G078 G080	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
1st– 2nd–	G111 G113	G230 G238	G231 G239	G079 G081					SHA11	SHA10	SHA09	SHA08
1st– 2nd–	G229 G233	G227 G235	G227 G235	G070 G074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
1st– 2nd–	G230 G234	G266 G234	G226 G234	G071 G075	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
1st– 2nd–	G231 G235	G229 G237	G229 G237	G072 G076	RCHHGA	MFNHGA	INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA

(2) Output signals (CNC→PMC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	F281 F285	F229 F245	F229 F245	F045 F049	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
1st– 2nd–	F282 F286	F228 F244	F228 F244	F046 F050					RCFNA	RCHPA	CFINA	CHPA

2.2.3 Related Parameters

Parameter No.				Description
0	15	15*i*	16*i*/16	
6515 #0	3015 #0	3015 #0	4015 #0	Spindle orientation function (Specify 1.)
0080 #3, 2	5609 #3, 2	5609 2	3702 #3, 2	Spindle orientation function of stop position external setting type (#2: First spindle, #3: Second spindle)
6501 #2	3001 #2	3001 #2	4001 #2	Use of a position coder signal (Specify 1.)
6500 #2	3000 #2	3000 #2	4000 #2	Relationship between rotation directions of spindle and position coder
6500 #0	3000 #0	3000 #0	4000 #0	Relationship between rotation directions of spindle and motor
6503 #0	3003 #0	3003 #0	4003 #0	Choice of orientation method (Specify 0.)
6503 #3, 2	3003 #3, 2	3003 #3, 2	4003 #3, 2	Rotation direction on orientation
6503 #7, 6, 5, 4	3003 #7, 6, 5, 4	3003 #7, 6, 5, 4	4003 #7, 6, 5, 4	Setting of position coder signal
6517 #2	3017 #2	3017 #2	4017 #2	Position coder rotation signal detection function in normal rotation
6517 #7	3017 #7	3017 #7	4017 #7	Shortcut function for orientation specified from the stop state
6518#5	3018#5	3018#5	4018#5	Velocity command correction function in high–speed orientation
6518#6	3018#6	3018#6	4018#6	High–speed orientation function (Specify 1.)
6519#0	3019#0	3019#0	4019#0	Dead–zone compensation in Cs contouring control and orientation (Specify 1.)
6531	3031	3031	4031	Orientation stop position
6538	3038	3038	4038	Highest orientation speed
6542 to 6543	3042 to 3043	3042 to 3043	4042 to 4043	Velocity loop proportional gain on orientation
6550 to 6551	3050 to 3051	3050 to 3051	4050 to 4051	Velocity loop integral gain on orientation
6556 to 6559	3056 to 3059	3056 to 3059	4056 to 4059	Gear ratio
6560 to 6563	3060 to 3063	3060 to 3063	4060 to 4063	Position gain on orientation
6564	3064	3064	4064	Deceleration time constant restriction ratio
6575	3075	3075	4075	Orientation completion signal detection level
6577	3077	3077	4077	Orientation stop position shift value
6584	3084	3084	4084	Motor voltage setting on orientation
6598	3098	3098	4098	Maximum speed of position coder signal detection
6284 to 6287	3464 to 3467	3320 to 3323	4320 to 4323	Motor deceleration time constant
6290 6294	3470 3474	3326 3330	4326 4330	Deceleration time constant restriction start velocity
6292	3472	3328	4328	Command multiplier for orientation

2.2.4 Details of Parameters

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6518	3018	3018	4018		HSORI	HSVCM					

HSVCM: Velocity command correction at high–speed orientation
- 0: Not provided
- 1: Provided

Usually, specify : 0

HSORI: High–speed orientation function
- 0: Disabled
- 1: Enabled

Specify: 1

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6500	3000	3000	4000						POSC1		ROTA1

ROTA1: Relationship between rotation directions of spindle and motor
- 0: Same direction
- 1: Reverse direction

POSC1: Relationship between rotation directions of spindle and position coder
- 0: Same direction
- 1: Reverse direction

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6501	3001	3001	4001						POSC2		

POSC2: Use of position coder signal
- 0: Not used
- 1: Used

Specify: 1

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6503	3003	3003	4003	PCPL2	PCPL1	PCPL0	PCTYPE	DIRCT2	DIRCT1		PCMGSL

DIRCT2-DIRCT1:
Rotation direction at orientation

DIRCT2	DIRCT1	Rotation direction
0	0	Depends on the previous rotation direction (counterclockwise for the first rotation after power–up)
0	1	Depends on the previous rotation direction (clockwise for the first rotation after power–up)
1	0	Counterclockwise viewed from the motor shaft
1	1	Clockwise viewed from the motor shaft

PCMGSL: Choice of orientation method

0: Position coder method

1: Magnetic sensor method

Specify: 0

PCPL2, PCPL1, PCPL0, PCTYPE: Position coder signal setting
Specify these bits according to the detector type. (When using a position coder, specify 0,0,0,0.)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6517	3017	3017	4017	NRROEN					RFCHK4		

RFCHK4: Position coder one–rotation signal detection function in normal rotation

0: Not provided

1: Provided

If this bit is set to 1, the orientation time after rotation at a speed exceeding the maximum speed of position coder signal detection (Parameter No. 4098) can be reduced.

NRROEN: Shortcut function for orientation specified from the stop state

0: Not provided

1: Provided

If this bit is set to 1, the shortcut function is used when the following conditions are satisfied:

i) Bit 7 (RFCHK3) of parameter No. 4016 is set to 0.

ii) Speed zero detection signal SST, which is a output signal, is set to 1.

iii) Shortcut command NRROA, which is a input signal, is set to 1.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6519	3019	3019	4019								DTTMCS

DTTMCS: Dead–zone compensation in Cs contouring control and high–speed orientation

0: Not provided

1: Provided

Specify: 1

0	15	15*i*	16*i*/16	
6531	3031	3031	4031	Position coder method orientation stop position

Data unit : 1 pulse (360 degrees/4096)

Data range : 0 to 4096

Standard setting : 0

This parameter specifies the stop position of position coder method orientation. For spindle orientation of stop position external setting type or incremental command external setting type, this parameter is invalid. Instead, the stop position command (SHA11 to SHA00), which is a input signal, becomes valid.

0	15	15*i*	16*i*/16	
6538	3038	3038	4038	Upper limit of spindle orientation speed

Data unit : 1 min^{-1}

Data range : 0 to 32767

Standard setting : 0

This parameter specifies the upper limit of orientation speed at the spindle end. If 0 is set in this parameter, the motor magnetic flux down start speed (parameter No. 4103) converted for the spindle side is assumed.

0	15	15*i*	16*i*/16		
6542	3042	3042	4042	Velocity loop proportional gain on orientation (HIGH)	CTH1A=0
6543	3043	3043	4043	Velocity loop proportional gain on orientation (LOW)	CTH1A=1

Data unit :

Data range : 0 to 32767

Standard setting : 10

These parameters specify velocity loop proportional gains on orientation.

0	15	15*i*	16*i*/16		
6550	3050	3050	4050	Velocity loop integral gain on orientation (HIGH)	CTH1A=0
6551	3051	3051	4050	Velocity loop integral gain on orientation (LOW)	CTH1A=1

Data unit :

Data range : 0 to 32767

Standard setting : 10

These parameters specify velocity loop integral gains on orientation.

0	15	15*i*	16*i*/16		
6556	3056	3056	4056	Gear ratio (HIGH)	CTH1A=0, CTH2A=0
6557	3057	3057	4057	Gear ratio (MEDIUM HIGH)	CTH1A=0, CTH2A=1
6558	3058	3058	4058	Gear ratio (MEDIUM LOW)	CTH1A=1, CTH2A=0
6559	3059	3059	4059	Gear ratio (LOW)	CTH1A=1, CTH2A=1

Data unit : Motor rotation per spindle rotation × 100 (motor rotation × 1000 if bit 1 (GRUNIT) of parameter No. 4006 is set to 1)
Data range : 3 to 3000 (33 to 30000 if bit 1 (GRUNIT) of parameter No. 4006 is set to 1)
Standard setting : 100

This function supports any gear ratio in the range of 1:30 to 30:1.

0	15	15*i*	16*i*/16		
6560	3060	3060	4060	Position gain on orientation (HIGH)	CTH1A, 2A=0, 0
6561	3061	3061	4061	Position gain on orientation (MEDIUM HIGH)	CTH1A, 2A=0, 1
6562	3062	3062	4062	Position gain on orientation (MEDIUM LOW)	CTH1A, 2A=1, 0
6563	3063	3063	4063	Position gain on orientation (LOW)	CTH1A, 2A=1, 1

Data unit : 0.01 sec^{-1}
Data range : 0 to 32767
Standard setting : 1000

These parameters specify position gains on orientation.

0	15	15*i*	16*i*/16	
6564	3064	3064	4064	Deceleration time constant restriction ratio

Data unit : 1%
Data range : 0 to 100
Standard setting : 100

This parameter specifies a restriction ratio of deceleration time constant in orientation from deceleration time constant restriction start velocity (parameter Nos. 4326, 4330) or below.

0	15	15*i*	16*i*/16	
6575	3075	3075	4075	Orientation completion signal detection level (in–position range)

Data unit : ±1 pulse
Data range : 0 to 100
Standard setting : 10

This parameter specifies the detection level of orientation completion signal (ORARA) which is a DO signal. If the positional deviation falls within the specified range, ORARA goes 1.

0	15	15*i*	16*i*/16	
6577	3077	3077	4077	Orientation stop position shift value

Data unit : ± 1 pulse
Data range : –4095 to 4095
Standard setting : 0

This parameter specifies a shift value of orientation stop position. Specifying a positive value shifts the spindle stop position counterclockwise by the specified number of pulses.

0	15	15*i*	16*i*/16	
6584	3084	3084	4084	Motor voltage setting on orientation

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

This parameter specifies the motor voltage in orientation. Usually, specify 100.

0	15	15*i*	16*i*/16	
6598	3098	3098	4098	Maximum speed of position coder signal detection

Data unit : 1 min^{-1}
Data range : 0 to 32767
Standard setting : 0

This parameter specifies the maximum speed at which the position coder signal is detected. If 0 is set in this parameter, the maximum motor speed (parameter No. 4020) is assumed.

0	15	15*i*	16*i*/16		
6284	3464	3464	4320	Motor deceleration time constant (HIGH)	CTH1A=0, CTH2A=0
6285	3465	3465	4321	Motor deceleration time constant (MEDIUM HIGH)	CTH1A=0, CTH2A=1
6286	3466	3466	4322	Motor deceleration time constant (MEDIUM LOW)	CTH1A=1, CTH2A=0
6287	3467	3467	4323	Motor deceleration time constant (LOW)	CTH1A=1, CTH2A=1

Data unit : 10 min^{-1}/sec
Data range : 0 to 6400
Standard setting : 0

These parameters specify motor deceleration time constants in high–speed orientation. If 0 is specified, the high–speed orientation function is disabled, and the normal orientation function is enabled.

The parameter settings are given as follows:

$$\text{Deceleration time constant} = \frac{\tau}{J} \times \frac{60}{2\pi} \times (0.8 \text{ to } 0.9)$$

where

τ (Nm) : Maximum motor torque at upper limit of orientation speed (No. 4038)

J (kgm^2) : Motor inertia + Load inertia

0	15	15*i*	16*i*/16	
6290	3470	3470	4326	Deceleration time constant restriction start velocity (HIGH) CTH1A=0
6294	3474	3474	4330	Deceleration time constant restriction start velocity (LOW) CTH1A=1

Data unit : 1 min^{-1}

Data range : 0 to 32767

Standard setting : 0

This parameter specifies the motor speed at which the restriction of deceleration time constant starts. If 0 is specified, the lowest orientation speed internally calculated by the software is assumed.

0	15	15*i*	16*i*/16	
6292	3472	3472	4328	Command multiplier for spindle orientation by a position coder

Data unit :

Data range : 0 to 32767

Standard setting : 0

This parameter specifies a command multiplier for spindle orientation function of incremental command external setting type. If 0 is set in this parameter, 1 is assumed.

2.3 MAGNETIC SENSOR METHOD SPINDLE ORIENTATION

2.3.1 Start–up Procedure

A. Check that the system is ready for normal operation.

↓

B. Prepare and check the ladder program for performing magnetic sensor method orientation.
(Refer to the Descriptions (B–65162E).)

↓

C. Set the necessary parameters for magnetic sensor method orientation. (See Section 2.3.3.)

↓

D. Set the necessary parameters for the magnetic sensor. (See Section 2.3.3.)
MS signal constant, MS signal gain, mounting direction of the magnetic sensor

↓

E. Check the connection and feedback signal of the magnetic sensor.

↓

F. Check that orientation is possible. NG → B

↓ OK

G. Set and check the direction of orientation.
- Set the direction of rotation for orientation.

↓

H. Adjust the orientation stop position.
- Detection level for the orientation completion signal
- Orientation stop position shift

↓

I. Adjust the orientation speed.
- Position gain for orientation
- Motor speed limit ratio for orientation
- Orientation speed

↓

J. Adjust the orientation stop–time.
(Eliminate any overshoot, and ensure rigidity in the stop state.)
- Position gain for orientation
- Velocity loop proportional gain for orientation
- Velocity loop integral gain for orientation
- Setting of motor voltage for orientation
- Rate of a change in the position gain when orientation is stopped

↓

K. Check ATC operation.

2.3.2 Spindle Control Signals

(1) Input signals (PMC to CNC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	G229 G233	G227 G235	G227 G235	G070 G07	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
1st– 2nd–	G230 G234	G226 G234	G226 G234	G071 G075	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA

(2) Output signals (CNC to PMC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	F281 F285	F229 F245	F229 F245	F045 F049	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
1st– 2nd–	F282 F286	F228 F244	F228 F244	F046 F050					RCFNA	RCHPA	CFINA	CHPA

2.3.3 Parameters

Parameter No.				Description
0	**15**	**15*i***	**16*i*/16**	
6515 #0	3015 #0	3015 #0	4015 #0	Support of spindle orientation function (Set 1.) (The CNC software option is required.)
6501 #3	3001 #3	3001 #3	4001 #3	Mounting direction of magnetic sensor
6500 #0	3000 #0	3000 #0	4000 #0	Direction of spindle and motor rotation
6503 #0	3003 #0	3003 #0	4003 #0	Selection of a spindle orientation function; position coder method or magnetic sensor method (To select magnetic sensor method spindle orientation, specify 1.)
6503 #3, 2	3003 #3, 2	3003 #3, #2	4003 #3, 2	Direction of rotation in spindle orientation
6542 6543	3042 3043	3042 3043	4042 4043	Velocity loop proportional gain for orientation (A parameter is selected by the CTH1A input signal.)
6550 6551	3050 3051	3050 3051	4050 4051	Velocity loop integral gain for orientation (A parameter is selected by the CTH1A input signal.)
6556 to 6559	3056 to 3059	3056 to 3059	4056 to 4059	Spindle–to–motor gear ratio (A parameter is selected by the CTH1A and CTH2A input signals.)
6560 to 6563	3060 to 3063	3060 to 3063	4060 to 4063	Position gain for orientation (A parameter is selected by the CTH1A and CTH2A input signals.)
6564	3064	3064	4064	Rate of change in position gain upon completion of spindle orientation
6575	3075	3075	4075	Detection level for the spindle orientation completion signal
6576	3076	3076	4076	Motor speed limit for spindle orientation
6577	3077	3077	4077	Spindle orientation stop position shift
6578	3078	3078	4078	MS signal constant
6579	3079	3079	4079	MS signal gain adjustment
6584	3084	3084	4084	Motor voltage for spindle orientation
6538	3038	3038	4038	Spindle orientation speed

Parameters on the sub spindle side of spindle switching control

Parameter No.				Description
0	**15**	**15*i***	**16*i*/16**	
6141 #2	3321 #2	3177 #3	4177 #3	Mounting direction of the magnetic sensor
6140 #0	3320 #0	3176 #0	4176 #0	Direction of spindle and motor rotation
6143 #0	3323 #0	3179 #0	4179 #0	Selection of a spindle orientation function; position coder method or magnetic sensor method (To select magnetic sensor method spindle orientation, specify 1.)
6143 #3, 2	3323 #3, 2	3179 #3, #2	4179 #3, 2	Direction of rotation in spindle orientation
6172 6173	3352 3353	3208 3209	4208 4209	Velocity loop proportional gain for orientation (A parameter is selected by the CTH1A input signal.)
6177	3357	3213	4213	Velocity loop integral gain for orientation
6180 6181	3360 3361	3216 3217	4216 4217	Spindle–to–motor gear ratio (A parameter is selected by the CTH1A input signal.)
6182 6183	3362 3363	3218 3219	4218 4219	Position gain for orientation (A parameter is selected by the CTH1A input signal.)
6184	3364	3220	4220	Rate of a change in the position gain upon completion of spindle orientation
6190	3370	3226	4226	Detection level for the spindle orientation completion signal
6191	3371	3227	4227	Motor speed limit for spindle orientation
6192	3372	3228	4228	Spindle orientation stop position shift
6193	3373	3229	4229	MS signal constant
6194	3374	3230	4230	MS signal gain adjustment
6201	3381	3237	4237	Motor voltage for spindle orientation
6169	3349	3205	4205	Spindle orientation speed

2.3.4 Ditail of Parameter

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	6500 6640	3000 3140	3000	4000								ROTA

Standard setting: 0 0 0 0 0 0 0 0

ROTA: Indicates the relationship between the rotation directions of spindle and spindle motor.

0: Rotates the spindle and spindle motor in the same direction.

1: Rotates the spindle and spindle motor in the reverse direction.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	6501 6641	3001 3141	3001	4001					MGSEN			

MGSEN: Indicates the mounting direction of magnetic sensor.

0: Rotates the motor and magnetic sensor in the same direction.

1: Rotates the motor and magnetic sensor in the reverse direction.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6503	3003	3003	4003					DIRCT2	DIRCT1		PCMGSL
2nd–	6643	3143										

Standard setting:	0	0	0	0	0	0	0	1

PCMGSL:

Selection of rotation direction on spindle orientation set to ”1” (Magnetic sensor).

DIRCT2-DIRCT1:

Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before (It is CCW at the power on)
0	1	By rotation direction immediately before (It is CW at the power on)
1	0	CCW (counterclockwise) direction looking from shaft of motor
1	1	CW (clockwise) direction looking from shaft of motor

When ”By rotation direction immediately before” is set, the rotation direction for spindle orientation is determined from the direction of the previous rotation at the zero speed detection level or a higher speed (when the SST output signal is set to 0).

	0	15	15*i*	16*i*/16	
1st–	6538	3038	3038	4038	Spindle orientation speed
2nd–	6678	3178			

Data unit : 1 min^{-1} (10 min^{-1} when bit 2 of parameter No. 4006 (SPDUNT) is set to 1)

Data range : 0 to 32767

Standard setting : 0

This parameter sets the orientation speed at the end of the spindle.

When 0 is specified for this parameter, the orientation speed is determined depending on the position gain and the motor speed limit ratio for orientation.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6542 6682	3042 3182	3042	4042	Velocity loop proportion gain on orientation (HIGH gear) CTH1A=0
1st– 2nd–	6543 6683	3043 3183	3043	4043	Velocity loop proportion gain on orientation (LOW gear) CTH1A=1

Data unit :
Data range : 0 to 32767
Standard setting : 10

This parameter sets the velocity loop proportional gain for spindle orientation.
When the CTH1A input signal is set to 0, proportional gain for the HIGH gear is selected. When the CTH1A input signal is set to 1, proportional gain for the LOW gear is selected.
Using these parameters, the response during orientation deceleration, as well as, and rigidity in the orientation stop state, can be adjusted.
Set the maximum allowable values that do not cause vibration in the orientation stop state.

	0	15	15*i*	16*i*/16	
1st– 2nd–	6550 6690	3050 3190	3050	4050	Velocity loop integral gain on orientation (HIGH gear) CTH1A=0
1st– 2nd–	6551 6691	3051 3191	3051	4051	Velocity loop integral gain on orientation (LOW gear) CTH1A=1

Data unit :
Data range : 0 to 32767
Standard setting : 10

This parameter sets the velocity loop integral gain for the spindle orientation.
When the CTH1A input signal is set to 0, integral gain for the HIGH gear is selected. When the CTH1A input signal is set to 1, integral gain for the LOW gear is selected.
Rigidity in the orientation stop state is adjusted using these parameters.
To adjust the velocity loop integral gain, specify a value that is one to five times greater than the velocity loop proportional gain set in parameter No. 4042.

	0	15	15*i*	16*i*/16		
1st–	6556	3056	3056	4056	Gear ratio (HIGH)	CTH1A=0, CTH2A=0
2nd–	6696	3196				
1st–	6557	3057	3057	4057	Gear ratio (MEDIUM HIGH)	CTH1A=0, CTH2A=1
2nd–	6697	3197				
1st–	6558	3058	3058	4058	Gear ratio (MEDIUM LOW)	CTH1A=1, CTH2A=0
2nd–	6698	3198				
1st–	6559	3059	3059	4059	Gear ratio (LOW)	CTH1A=1, CTH2A=1
2nd–	6699	3199				

Data unit : Motor rotation for one rotation of spindle × 100 (When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation × 1000)

Data range : 0 to 32767

Standard setting : 100

These parameters set the gear ratio of the spindle motor relative to the spindle.

When the motor rotates 2.5 time for every rotation of the spindle, for example, set 250 in the parameter.

A parameter is selected by the CTH1A and CTH2A input signals.

The gear or clutch status must correspond to the status of the CTH1A and CTH2A input signals.

	0	15	15*i*	16*i*/16		
1st–	6560	3060	3060	4060	Position gain on orientation (HIGH)	CTH1A=0, CTH2A=0
2nd–	6700	3200				
1st–	6561	3061	3061	4061	Position gain on orientation (MEDIUM HIGH)	CTH1A=0, CTH2A=1
2nd–	6701	3201				
1st–	6562	3062	3062	4062	Position gain on orientation (MEDIUM LOW)	CTH1A=1, CTH2A=0
2nd–	6702	3202				
1st–	6563	3063	3063	4063	Position gain on orientation (LOW)	CTH1A=1, CTH2A=1
2nd–	6703	3203				

Data unit : 0.01 sec^{-1}

Data range : 0 to 32767

Standard setting : 1000

These data are used to set the position gain on orientation.

Parameter is set depend on input signal CTH1A or CTH2A.

	0	15	15*i*	16*i*/16	
1st–	6564	3064	3064	4064	Modification rate of position gain on orientation completion
2nd–	6704	3204			

Data unit : 1%

Data range : 0 to 1000

Standard setting : 100

This data is used to set the modification rate of position gain on spindle orientation completion.

0	15	15*i*	16*i*/16

1st–	6575	3075	3075	4075	Orientation completion signal detection level
2nd–	6715	3215			

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.1 degree unit

Data range : 0 to 100

Standard setting : 10

This data is used to set the detecting level of orientation completion signal (ORARA).
When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORARA) in the spindle control signals is set to ”1”.

	0	15	15*i*	16*i*/16	
1st–	6576	3076	3076	4076	Motor speed limit value on orientation
2nd–	6716	3216			

Data unit : 1%

Data range : 0 to 100

Standard setting : 33

This data is used to set the motor speed limit value on orientation.

Orientation speed of motor = Position gain × Gear ratio × 60 min^{-1}
Speed limit value = Orientation speed of motor × (Setting data)/100 min^{-1}

	0	15	15*i*	16*i*/16	
1st–	6577	3077	3077	4077	Orientation stop position shift value
2nd–	6717	3217			

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.01 degree unit

Data range : Position coder method → – 4095 to 4095
Magnetic sensor method → –100 to 100

Standard setting : 0

In the position coder method orientation, set this data to shift stop position.
Spindle is shift No. of setting pulse in CCW direction, and stops by data (+).

0	15	15*i*	16*i*/16	
6578 6718	3078 3218	3078	4078	MS signal constant = (L/2)/(2 × π × H) × 4096

L: Length of magnetizing element (mm)
H: Distance from spindle center to magnetizing element (mm)

Data unit :
Data range : 80 to 1000
Standard setting : 200

In the magnetic sensor method orientation, substitute the followings into the expression above to set the MS signal constant.

L: Length of magnetizing element (mm)
H: Distance from spindle center to magnetizing element (mm)

Name	Specification drawing No.	Magnetizing element		MS signal gain
		Type	Length [mm]	
No specification, standard	A57L–0001–0037	Standard (type II)	50	0
Magnetic sensor N	A57L–0001–0037/N			0
Magnetic sensor P	A57L–0001–0037/P	Small type (type III)	50	–20
Magnetic sensor Q	A57L–0001–0037/Q	Cylindrical, 40 in diameter (type IV)	31	70
Magnetic sensor R	A57L–0001–0037/R	Cylindrical, 50 in diameter (type V)	37	50
Magnetic sensor S	A57L–0001–0037/S	Cylindrical, 60 in diameter (type VI)	43	70
Magnetic sensor T	A57L–0001–0037/T	Cylindrical, 70 in diameter (type VII)	49	40

Example

When H = 100 mm, and L = 50 mm

MS signal constant = (50/2) / (2π × 100) × 4096 ≐ 163

0	15	15*i*	16*i*/16	
6579 6719	3079 3219	3079	4079	MS signal gain adjustment

Data unit :
Data range : –128 to +127
Standard setting : 0

Use this parameter when adjusting the amplitude of the MS signal in the magnetic sensor method orientation. Set the constant of above table normally.

0	15	15*i*	16*i*/16	
6584 6724	3084 3224	3084	4084	Motor voltage setting on orientation

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model

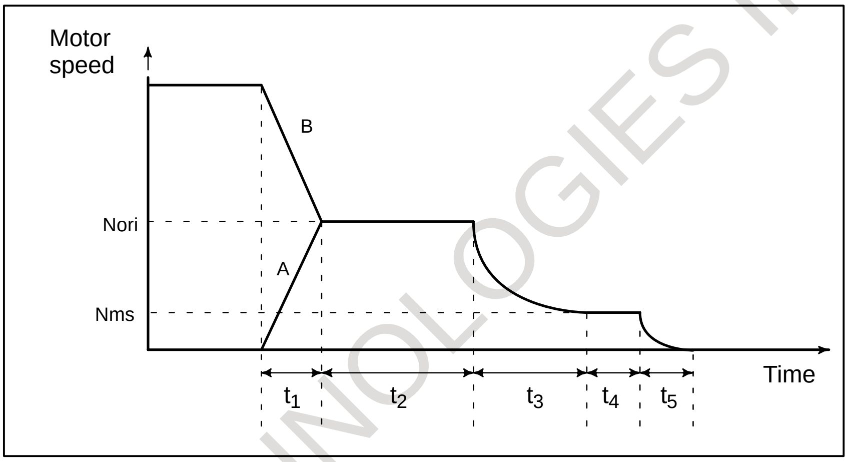
This parameter sets the motor voltage for orientation.

2.3.5 Calculating the Orientation Time

(1) Calculating the orientation time

In the following explanation, the time, from the input of an orientation command until orientation stops, is divided into five periods.

In the following figure, A indicates that the motor in the stop state starts rotating and is accelerated to the orientation speed. B indicates that the already rotating motor is decelerated to the orientation speed.



t_1: Time required to achieve orientation speed Nori [sec]

t_2: Time from the detection of a one–rotation signal (0 to 1 rotation) after Nori is achieved, until deceleration starts (1 – Rori rotation) [sec]

t_3: Time from the start of deceleration until speed Nms is achieved [sec]

t_4: Time from reaching Nms until the LS signal is detected [sec]

t_5: Time from detection of the LS signal until orientation is completed [sec]

(a) t_1 is measured on the actual machine.

Orientation speed Nori [min^{-1}] is calculated from position gain PG [sec^{-1}] and the motor speed limit ratio for orientation Rori.

$\text{Nori} = \text{PG} \times 60 \times \text{Rori}$

(b) t_2 is the time required to rotate (1 – Rori) to (2 – Rori) turns at orientation speed Nori [min^{-1}].

$(1 - \text{Rori}) \times 60 \quad \text{Nori} \leqq t_2 \leqq (2 - \text{Rori}) \times 60 \quad \text{Nori}$

$$\therefore \frac{1}{\text{PG} \times \text{Rori}} - \frac{1}{\text{PG}} \leqq t_2 \leqq \frac{2}{\text{PG} \times \text{Rori}} - \frac{1}{\text{PG}}$$

(c) For simplicity, t_3 will be calculated later, together with t_5.

(d) Speed Nms [min^{-1}] is calculated as follows:

$$Nms = \frac{L}{2} \times \frac{1}{2\pi H} \times 60 \times PG$$

where,
L : Length of the magnetizing element [mm]
H: Distance from the center of the spindle to the magnetizing element [mm]

t_4 is the time required to rotate (L/2)/2 H turns at speed Nms.

$$t_4 = \frac{(L\ \ 2)\quad 2\pi H}{Nms} \times 60 = \frac{1}{PG}$$

(e) Let the orientation completion width be within ± 1_. Then, t_3 and t_5 are expressed as follows:

$$t_3 + t_5 = \frac{1}{PG} \times \ln\ (360 \times Rori)$$

(f) Therefore, orientation time t [sec] (= $t_1 + t_2 + t_3 + t_4 + t_5$) can be expressed as follows:

$$t_1 + \frac{1}{PG \times Rori} + \frac{1}{PG}\ \ln\ (360 \times Rori) \leqq t \leqq t_1 + \frac{2}{PG \times Rori} + \frac{1}{PG}\ \ln\ (360 \times Rori)$$

(2) Calculation example
Time required to achieve the orientation speed t_1 = 0.5 [sec]
Position gain PG = 20 [sec^{-1}]
Motor speed limit ratio for orientation Rori = 0.33 (= 33%)
Then, orientation time t [sec] is obtained as follows:

$$0.5 + \frac{1}{20 \times 0.33} + \frac{1}{20}\ \ln\ (360 \times 0.33) \leqq t \leqq 0.5 + \frac{2}{20 \times 0.33} + \frac{1}{20}\ \ln\ (360 \times 0.33)$$

$$\therefore\ 0.890\ [sec] \leqq t \leqq 1.042\ [sec]$$

2.4 RIGID TAPPING

2.4.1 Start–up Procedure

A. Check that normal operation is possible.

↓

B. Prepare and check the rigid tapping ladder program. (See Section 2.4.2.)

↓

C. Set up the detector–related parameters according to the system configuration.
(See Sections 2.4.3 and 2.4.4.)

- Specify to use the position coder signal.
- Set up the position coder signal.
- Specify the rotation direction of the spindle and motor and that of the spindle and position coder.
- Set up the gear ratio between the spindle and motor.
- Specify an arbitrary gear ratio (for rigid tapping that uses a signal from the MZ sensor incorporated in the motor when the gear ratio between the spindle and motor is not 1:1).

↓

D. Adjust the parameters according to the adjustment procedure. (See Section 2.4.5.)

- Maximum rotation speed and acceleration/deceleration time constant for rigid tapping
- Position gain for rigid tapping
- Velocity loop proportional and integration gains for rigid tapping
- Motor voltage for rigid tapping
- Motor activation delay

↓

E. Check the precision by actually performing cutting.
If there is a problem with the precision of the machine, adjust the acceleration/deceleration time constant and velocity loop gains again.

2.4.2 Spindle Control Signals Relating to Rigid Tapping

(1) Input signals (PMC→CNC)

(a) Series 0

	0TT HEAD2	#7	#6	#5	#4	#3	#2	#1	#0
G118	G1318					GR2 (*1)	GR1 (*1)		
G123	G1323					GR2 (*2)	GR1 (*2)	RGTPN (*3)	
G135	G1335								RGTAP (*4)
G145	G1345		GR21 (*6)					SWS2 (*5)	SWS1 (*5)
G229	G1429			SFRA		CTH1A	CTH2A		

(*1) This signal is effective when parameter 0031#5=0 in the T series

(*2) This signal is effective when parameter 0031#5=1 in the T series
This signal is also effective when M series with the surface speed constant control option.

(*3) This signal is effective when parameter 0019#4=0
(This signal is always effective only for T/TT series.)

(*4) This signal is effective when parameter 0019#4=1
(This signal is ineffective for T/TT series.)

(*5) The rigid tapping of the second spindle is available by the multi-spindle control function.
When SWS1 is set to 1 (regardless of whether SWS2 is set to 0 or 1), rigid tapping is performed using the 1st spindle.
When SWS1 is set to 0, and SWS2 is set to 1, rigid tapping is performed using the 2nd spindle.

(*6) This signal is used when the rigid tapping of the second spindle.
According to the GR21 signal, the individual gear parameters for gear 1 or 2, also used for the 1st spindle, are selected.

(b) Series 15*i*/15

	#7	#6	#5	#4	#3	#2	#1	#0
G026								SPSTP
G227			SFRA		CTH1A	CTH2A		

(c) Series 16/18

	TT–HEAD2	#7	#6	#5	#4	#3	#2	#1	#0
G028	G1028						GR2	GR1	
G061	G1061								RGTAP
G027	G1027							SWS2 (*1)	SWS1 (*1)
G029	G1029								GR21 (*2)
G070	G1070			SFRA		CTH1A	CTH2A		

(*1) The rigid tapping of the second spindle is available by the multi-spindle control function.
When SWS1 is set to 1 (regardless of whether SWS2 is set to 0 or 1), rigid tapping is performed using the first spindle.
When SWS1 is set to 0, and SWS2 is set to 1, rigid tapping is performed using the second spindle.

(*2) This signal is used when the rigid tapping of the second spindle.
According to the GR21 signal, the individual gear parameters for gear 1 or 2, also used for the first spindle, are selected.

(2) Output signal (CNC $\rightarrow$ PMC)

(a) Series 0

	#7	#6	#5	#4	#3	#2	#1	#0
F152 (*1)						GR3O	GR2O	GR1O

(*1) These signals are effective when Machining system.

(b) Series 15*i*/15

	#7	#6	#5	#4	#3	#2	#1	#0
F040				RTAP				

(c) Series 16/18

	#7	#6	#5	#4	#3	#2	#1	#0
F034 (*1)						GR3O	GR2O	GR1O

(*1) These signals are effective when Machining system.

2.4.3 Rigid Tapping Parameter Table

Parameter number					**Remarks**
0M/T/TT		**15M/T**	**15*i***	**16*i*/16 M/T/TT**	
Fst. sp	**Snd. sp**				
0256		–	–	5210	M code of rigid tapping command
0031 #5 (T)		–	–	–	Address selection of gear signal
0019 #4 (M)		–	–	–	Input signal selection of rigid tapping
6501 #2	6641 #2	3001 #2	3001 #2	4001 #2	Position coder signal
6500 #0	6640 #0	3000 #0	3000 #0	4000 #0	Rotation direction of spindle
6500 #2	6640 #2	3000 #2	3000 #2	4000 #2	Attached direction of position coder
0028 #7, 6 0003 #7, 6	0064 #7, 6	5610	–	3706 #1, 0 3707 #1, 0	Gear ratio between spindle and position coder, 1:1, 1:2, 1:4, 1:8
6503 #7, 6, 5, 4	6643 #7, 6, 5, 4	3003 #7, 6, 5, 4	3003 #7, 6, 5, 4	4003 #7, 6, 5, 4	Setting of position coder
6506 #7	6646 #7	3006 #7	–	4006 #7	Rigid tapping using the arbitrary gear ratio (command) in the built–in MZ sensor
–		–	5842	–	Number of pulse of the position coder
0063 #3 (M) 0063 #6 (T)		5604 #2, 1	–	5200 #1	Selection of arbitrary gear ratio between spindle and position coder
(M) 0663 0664 0665	(T) 0427 to 0430	5703 5771 to 5774	5852 5855 5858 5861	5221 5222 5223 5224	Teeth number of spindle side at arbitrary gear ratio setting
(M) 0666 0667 0668	(T) 0431 to 0434	5704 5781 to 5784	5851 5854 5857 5860	5231 5232 5233 5234	Teeth number of position coder side at arbitrary gear ratio setting
6556 to 6559	6696 to 6699	3056 to 3059	3056 to 3059	4056 to 4059	Gear ratio between spindle and motor (It is selected by input signal CTH1A or CTH2A)
(M) 0615 0669 0670 0671	(T) 0406 to 0410	3065 to 3068	3065 to 3068	5280 5281 to 5284	Position gain of tapping axis at rigid tapping
6565 to 6568	6705 to 6708	3065 to 3068	3065 to 3068	4065 to 4068	Position gain of spindle at rigid tapping (It is selected by input signal CTH1A or CTH2A)
0037 #6		–	–	–	Stepless time constant selection
0254		5605 #1	5605 #1	–	Acc/Dec type
(M) 0613	(T) 0415 to 0418	5605 #2 5751 5760 5762 5764	5605 #2 5751 5886 5889 5892	5261 5262 5263 5264	Acc/Dec time constant

Parameter number					Remarks
0M/T/TT		15M/T	15*i*	16*i*/16 M/T/TT	
Fst. sp	Snd. sp				
Parameter number					**Remarks**
OM/T/TT		**15M/T**	**15*i***	**16*i*/16 M/T/TT**	
Fst. sp	**Snd. sp**				
(M) 0617	(T) 0423 to 0426	5605 #2 5757 5758 5759	5605 #2 5757 5884 5887 5890 5893	5241 5242 5243 5244	Spindle maximum speed at rigid tapping
(M only) 0614		5605 #2 5752 5761 5763 5765	5605 #2 5752 5885 5888 5891 5894	– – – – –	Low end speed at exponential type
0063 #4		–	–	5200 #4	Override selection at extracting
0258		–	5883	5211	Override value at extracting
–		–	–	5201 #2 5271 to 5274	Time constant at extracting
0618		1827	1827	5300	In-position width of tapping axis
0619		5755	5875	5301	In-position width of spindle
0620		1837	1837	5310	Alowable level of position error of tapping axis at moving
0621		5754	5876	5301	Alowable level of position error of spindle at moving
0622		–	1829	5312	Alowable level of position error of tapping axis at stop
0623		–	5877	5313	Alowable level of position error of spindle at stop
(M) 0255	(T) 0214 to 0217	5604 #2 5756 5791 to 5794	5853 5856 5859 5862	5321 to 5324	Backlash of spindle
6544 6545	6684 6685	3044 3045	3044 3045	4044 4045	Velocity loop proportional gain at rigid tapping (It is selected by input signal CTH1A/B.)
6552 6553	6692 6693	3052 3053	3052 3053	4052 4053	Velocity loop integral gain at rigid tapping (It is selected by input signal CTH1A/B.)
6585	6725	3085	3085	4085	Motor voltage at rigid tapping
6901	6941	3281	3137	4137	Motor voltage at rigid tapping (low speed)
6599	6739	3099	3099	4099	Delay time for stable motor excitation

2.4.4 Detail of Parameter for Rigid Tapping

(1) Set the parameter "Position coder signal is used"
The parameter setting address is as follows.

0 T/M/TT Fst. sp	0 T/TT Snd. sp	15 T/M	15*i*	16*i*/16 T/M/TT	Setting data
6501 #2	6641 #2	3001 #2	3001 #2	4001 #2	1

0: Position coder signal is not used
1: Position coder signal is used

(2) Set the parameter "Rotation direction of the motor and the spindle"
The parameter setting address is as follows.

0 T/M/TT Fst. sp	0 T/TT Snd. sp	15 T/M	15*i*	16*i*/16 T/M/TT
6500 #0	6640 #0	3000 #0	3000 #0	4000 #0

0: Spindl and motor are the same direction
1: Spindl and motor are the reverse direction

The rotation direction is judged from the same direction facing to the motor Normally to the shaft of motor and the spindle.

SetHThe same directionIin case of the built– in motor.

(3) Set the parameter "Attached direction of the position coder"
The parameter setting address is as follows.

FS0 T/M/TT Fst. sp	FS0 T/TT Snd. sp	FS15 T/M	15*i*	16*i*/16 T/M/TT
6500 #2	6640 #2	3000 #2	3000 #2	4000 #2

0: The spindle and the position coder is the same direction
1: The spindle and the position coder is the reverse direction

The rotation direction of the position coder is judged facing to the position coder shaft.

The rotation direction of the spindle is judged from the same direction facing to the motor (Normally to the shaft).

(4) Set the parameter "Number of pulse of the position coder"

0	15	15*i*	16*i*/16	Setting data
–	–	5842	–	4096

(5) Parameter setting relating to the system in which the position coderis used.

When the gear ratio between the spindle and the position coder is 1: 2, 1: 4, and 1: 8.

Refer to each CNC operation manual about the relation between the gear ratio and the parameter setting data.

0 M Fst. sp	0 T/TT Fst. sp	0 T/TT Snd. sp	15 T/M	15*i*	16*i*/16 T/M/TT Fst. sp	16*i*/16 T/TT Snd. sp
0028 #7, 6	0003 #7, 6	0064 #7, 6	5610	–	3706 #1, 0	3707 #1, 0

(6) Parameter setting relating to the system in which the MZ sensor or BZ sensor is used.

When rigid tapping is to be performed using a MZ sensor or BZ sensor, or when a built–in motor with a BZ sensor is being used, the following parameters must be specified.

(a) Set the following parameter according to the pulse number of the MZ sensor or BZ sensor.

FS0 T/M/TT Fst. sp	FS0 T/TT Snd. sp	FS15 T/M	15*i*	16*i*/16 T/M/TT
6503#7,6,5,4	6643#7,6,5,4	3003#7,6,5,4	3003#7,6,5,4	4003#7,6,5,4

#7	#6	#5	#4	
0	0	0	0 :	For 256λ/rev
0	0	0	1 :	For 128λ/rev
0	1	0	0 :	For 512λ/rev
0	1	0	1 :	For 64λ/rev
1	1	0	0 :	For 384λ/rev

(b) Set the following parameters when the gear ratio between the spindle and the motor (the sensor) is not 1: 1. (except for orientation based on the external one–rotation signal)

i) Set the parameter “Doing the rigid tapping by using the arbitrary rear ratio (command) in the built–in MZ sensor”.

FS0 T/M/TT Fst. sp	FS0 T/TT Snd. sp	FS15 T/M	15*i*	16*i*/16 T/M/TT	setting data
6506 #7	6646 #7	3006 #7	3006 #7	4006 #7	1

0: Except the below case

1: Doing the rigid tapping by using the MZ sensor

ii) Set the parameter to validate “the arbitrary gear ratio between the spindle and the position coder”.

0 M	0 T/TT	15 T/M	15*i*	16*i*/16 T/M/TT
0063 #3	0063 #6	5604 #2, 1	–	5200 #1

iii) Set the parameter “the arbitrary gear ratio between the spindle and the position coder” according to each CNC.

Series 0

- Set the gear teeth number of the spindle side.

Each parameter is selected according to the gear selection signal.

Standard machining: GR3O, GR2O, GR1O

Turning and maching with surface speed constant option: GR2, GR1

Second spindle of turning: GR21
(Multi– spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter NO
GR1O	GR2O	GR3O	
1	0	0	663
0	1	0	664
0	0	1	665

Turning [T/TT series] and maching [M series] with surface speed constant

Gear selection signal			Parameter NO	
Fst. sp		Snd. sp		
GR1	GR2	GR21	T/TT	M
0	0	0	427	663
1	0	1	428	664
0	1	—	429	665
1	1	—	430	—

- Set the gear teeth number of the position coder side.

  Each parameter is selected according to the gear selection signal.

  Standard machining: GR3O, GR2O, GR1O

  Turning and maching with surface speed constant option: GR2, GR1

  Second spindle of turning: GR21
  (Multi– spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter NO
GR1O	GR2O	GR3O	
1	0	0	666
0	1	0	667
0	0	1	668

Turning [T/TT series] and maching [M series] with surface speed constant

Gear selection signal			Parameter NO	
Fst. sp		Snd. sp		
GR1	GR2	GR21	T/TT	M
0	0	0	431	666
1	0	1	432	667
0	1	—	433	668
1	1	—	434	—

Series 15

(a) Only one arbitrary gear ratio parameter is valid in case of 5604#1=1, 5604#2=0.

	Parameter NO
Gear teeth number of spindle side	5703
Gear teeth number of position coder side	5704

(b) Four kinds of arbitrary gear ratio parameters are valid in case of 5604#2=1.

Each parameter is selected according to the gear selection signal (CTH1A, CTH2A) .

Gear signal		Parameter number	
CTH1A	CTH2A	Gear teeth number of spindle side	Gear teeth number of position coder side
0	0	5771	5781
0	1	5772	5782
1	0	5773	5783
1	1	5774	5784

Series 15*i*

Gear signal		Parameter number	
CTH1A	CTH2A	Gear teeth number of spindle side	Gear teeth number of position coder side
0	0	5852	5851
0	1	5855	5854
1	0	5858	5857
1	1	5861	5860

Series 16*i*/16

- Set the gear teeth number of the spindle side.

Each parameter is selected according to the gear selection signal.

Standard machining: GR3O, GR2O, GR1O

Turning and maching with surface speed constant option: GR2, GR1

Second spindle of turning: GR21
(Multi– spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter NO
GR1O	GR2O	GR3O	
1	0	0	5221
0	1	0	5222
0	0	1	5223

Turning [T/TT series] and maching [M series] with surface speed constant

Gear selection signal			Parameter NO	
Fst. sp		Snd. sp		
GR1	GR2	GR21	T/TT	M
0	0	0	5221	
1	0	1	5222	
0	1	—	5223	
1	1	—	5224	5223

- Set the gear teeth number of the position coder side.

  Each parameter is selected according to the gear selection signal.

  Standard machining: GR3O, GR2O, GR1O

  Turning and maching with surface speed constant option: GR2, GR1

  Second spindle of turning: GR21
  (Multi– spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter NO
GR1O	GR2O	GR3O	
1	0	0	5231
0	1	0	5232
0	0	1	5233

Turning [T/TT series] and maching [M series] with surface speed constant

Gear selection signal			Parameter NO	
Fst. sp		Snd. sp		
GR1	GR2	GR21	T/TT	M
0	0	0	5231	
1	0	1	5232	
0	1	—	5233	
1	1	—	5234	5233

(7) Parameter setting ofHGear ratio between the spindle and the motorI

The loop gain constant parameter is not used in the αseries (Serial) spindle system.

HGear ratio between the spindle and the motorIparameter should be set instead of it.

Each parameter is selected according to the gear selection signal (CTH1A/ B, CTH2A/ B) .

About the setteing data, refer to the 3. parameter explanation.

[0M/T/TT Fst. sp, 15M/T, 15*i*, 16*i*/16 T/M/TT Fst. sp]

Gear signal		Parameter number			
CTH1A	CTH2A	0M/T/TT Fst.sp	15M/T	15*i*	16(18)T/M/ TT Fst. sp
0	0	6556	3056	3056	4056 (S1)
0	1	6557	3057	3057	4057 (S1)
1	0	6558	3058	3058	4058 (S1)
1	1	6559	3059	3059	4059 (S1)

[0T/TT Snd. sp, 16 (18) T/TT Snd. sp]

Gear signal		Parameter number	
CTH1B	CTH2B	0M/T/TT Snd. sp	16(18)T/M/TT Snd. sp
0	0	6696	4056 (S2)
0	1	6697	4057 (S2)
1	0	6698	4058 (S2)
1	1	6699	4059 (S2)

(8) Parameter setting of ”Position gain”

(a) Intial setting of position gain

In the rigid tapping, the tapping axis and the spindle is controlled to be synchronized.

So, the position gain of the tapping axis and the spindle must be set to the same value.

When a built–in motor is being used, the position gain must be initialized to 3000 (30 sec^{-1}). When the spindle is driven by a gear or belt, the position gain must be initialized to 2000 to 2500 (20 to 25 sec^{-1}).

The position gain is subject to change in some circumstances.

(b) In case of Series 0

The position gain parameter of the tapping axis in the rigid tapping is selected as follows according to the gear selection signal.

Standard machining: GR3O, GR2O, GR1O

Turning and maching with surface speed constant option: GR2, GR1

Second spindle of turning: GR21
(Multi– spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter NO
GR1O	GR2O	GR3O	
			615 (*1)
1	0	0	669
0	1	0	670
0	0	1	671

Turning [T/TT series] and maching [M series]

with surface speed constant

Gear selection signal			Parameter NO	
Fst. sp		Snd. sp		
GR1	GR2	GR21	T/TT	M
		(*1)	406	615
0	0	0	407	669
1	0	1	408	670
0	1		409	671
1	1		410	

(*1) When this parameter is “0”, each gear parameter becomes valid. When this parameter is not “0”, each gear parameter becomes invalid, and this parameter is always used.

The position gain parameter of the spindle in the rigid tapping is selected as follows according to the gear selection signal (CTH1A/ B, CTH2A/B) .
(This is common of T series and M series)

[Fst. sp]

Gear signal		Parameter NO
CTH1A	CTH2A	
0	0	6565
0	1	6566
1	0	6567
1	1	6568

[Snd. sp]

Gear signal		Parameter NO
CTH1B	CTH2B	
0	0	6705
0	1	6706
1	0	6707
1	1	6708

Take care to input the gear selection signals GR1, GR2, GR21, GR1O, GR2O, GR3O, and CTH1A, CTH2A according to the real gear state in order to get the same position gain of the tapping axis and that of the spindle, because GR1, GR2, GR21, GR1O, GR2O, GR3O, and CTH1A, CTH2A are inputted independently. Set to 0 for parameter which is not used.

(c) In case of Series 15

In the rigid tapping, the same parameter address data is used for the position gain of the tapping axis and the spindle.

Each position gain is selected as follows according to the gear selection signal (CTH1A, CTH2A) .

Gear signal		Parameter NO
CTH1A	CTH2A	
0	0	3065
0	1	3066
1	0	3067
1	1	3068

(d) In case of Series 15*i*

Gear signal		Parameter NO
CTH1A	CTH2A	
0	0	3065
0	1	3066
1	0	3067
1	1	3068

(e) In case of Series 16*i*/16

The position gain parameter of the tapping axis in the rigid tapping is selected as follows according to the gear selection signal.

Standard machining: GR3O, GR2O, GR1O

Turning (T/TT series) and maching (M series) with surface speed constant option: GR2, GR1

Second spindle of turning (T/TT series): GR21 (Multi–spindle control option is needed)

Standard machining [M series]

Gear signal			Parameter NO
GR1O	GR2O	GR3O	
			5280(*1)
1	0	0	5281
0	1	0	5282
0	0	1	5283

Turning [T/TT series] and maching [M series] with surface speed constant

Gear selection signal			Parameter NO	
Fst. sp		Snd. sp		
GR1	GR2	GR21	T/TT	M
			5280 (*1)	
0	0	0	5281	
1	0	1	5282	
0	1	—	5283	
1	1	—	5284	5283

(*1) When this parameter is ”0”, each gear parameter becomes valid. When this parameter is not ”0”, each gear parameter becomes invalid, and this parameter is always used.

The position gain parameter of the spindle in the rigid tapping is selected as follows according to hte gear selection signal (CTH1A/B, CTH2A/B). (This is common T series and M series)

[Fst. sp]

Gear signal		Parameter NO
CTH1A	CTH2A	
0	0	4065 (S1)
0	1	4066 (S1)
1	0	4067 (S1)
1	1	4068 (S1)

[Snd. sp]

Gear signal		Parameter NO
CTH1B	CTH2B	
0	0	4065 (S2)
0	1	4066 (S2)
1	0	4067 (S2)
1	1	4068 (S2)

Take care to input the gear selection signal GR1, GR2, GR21, GR1O, GR2O, GR3O and CTH1A/B, CTH2A/B according to the real gear state in order to get the same position gain of the tapping axis and that of the spindle, because GR1, GR2, GR21, GR1O, GR2O, GR3O and CTH1A/B, CTH2A/B are inputted independently. Set to 0 for parameter which is not used.

(9) Parameter setting relating to ”acceleration/deceleration time constant” and ”maximum spindle rotation speed for rigid tapping”

(a) How to determine the acceleration/deceleration time constant

(b) In case of Series 0

i) Set the steplessly switched time constant.

Machining (M series)	Turning (T/TT series)
0037 #6	(*1)

0 : Time constant is not steplessly switched in rigid tapping.
1 : Time constant is steplessly switched in rigid tapping. (Normal setting)

(*1) In T/TT series, the time constant is always steplessly switched in rigid tapping.

ii) Set ”Acc/Dec type”

Machining (M series)	Turning (T/TT series)
254	(*1)

0 : Exponential Acc/ Dec
1 : Linear Acc/ Dec (Standard setting)

(*1) Only linear Acc/ Dec is applied to T/TT series.

iii) ”Low end speed at rigid tapping exponential Acc/Dec” is set to the following address and is applied to all gear state. (It is ralid only for exporential Acc/Dec)

Machining (M series)	Turning (T/TT series)
614	(*1)

(*1) This function is not valid to T/TT series.

iv) The time constant of the tapping axis and the spindle is set on machining (M series) and Turning (T/TT series) as follows.

The time to get to the spindle maximum speed at the rigid tapping is set.

[Machining system (M series)]

Each gear time constant becomes valid by setting the parameter below.

0077 #1

0 : the same time constant for all gear

1 : each time constant for each gear

By setting the following parameter, the different time constant between the cutting in and cutting out (extracting) becomes available.

0035 #5

0 : The same time constant between cutting in and out.

1 : The different time constant between cutting in and out.

As an summary, refer to the table belows.

							Valid at 35#5=1		
Gear selection signal					**Time constant (Cutting in) Parameter NO**		**Time constant (Cutting out) Parameter NO**		**Rigid tapping spindle max. speed Parameter NO**
Standard Machining [M series]			**(*1)**						
GR1O	**GR2O**	**GR3O**	**GR1**	**GR2**	**77#1=0**	**77#1=1**	**77#1=0**	**77#1=1**	
1	0	0	0	0	613	692	402	400	617
0	1	1	1	0		693		401	
0	0	1	0	1		613		402	

(*1) The machining system (M series) with surface speed constant option.

[Turning system (T/TT series)]

Set the parameters as below according to the gear selection signal.

Fst. sp : GR2, GR1

Snd. sp : GR21 (Multi–spindle control option is needed)

By setting the following parameter, the different time constant between the cutting in and cutting out (extracting) becomes available.

0029 #3

0 : The same time constant between cutting in and out. (NO. 415 to 418)

1 : The different time constant between cutting in and out.
Cutting in : NO. 415 to 418
Cutting out : NO. 419 to 422

Gear selection signal			Time constant (Cutting in) Parameter NO	Time constant (Cutting out) Parameter NO	Rigid tapping spindle max. speed Parameter NO
Fst. sp		Snd. sp			
GR1	GR2	GR21			
0	0	0	415	419	423
1	0	1	416	420	424
0	1		417	421	425
1	1		418	422	426

v) The override at extracting

0063 #4

0 : The override at extracting is not valid.
1 : The override at extracting is valid.
(The override value is set to NO. 258)

(c) Series 15

i) Acc/Dec type

5605 #1

0 : Exponential type Acc/ Dec
1 : Linear type Acc/ Dec (Standard setting)

ii) Setting of "Low end speed of exponential type Acc/Dec" (It is valid for exponential type Acc/Dec)

- When 5605#2=0, the same parameter data is used for all gear and the address is

5752

- When 5605#2=1, each parameter can be set for each gear.
  Each parameter is selected according to the gear signal (CTH1A, CTH2A) .

Gear signal		Parameter NO
CTH1A	CTH2A	
0	0	5761
0	1	5763
1	0	5765

iii) Set Acc/Dec the time constant of the tapping axis and the spindle.

- When 5605#2=0, the same parameter data is used for all gear.
  The time to get to the spindle maximum speed at the rigid tapping is set.

Acc/Dec time constant	5751
Spindle maximum speed	5757

- When bit 2 of parameter No. 5605 is set to 1, one of the three acceleration/deceleration time constants is selected, depending on the spindle speed. When a spindle speed is specified, appropriate parameters are set automatically.

	Parameter No. for maximum spindle speed for rigid tapping	Parameter No. for acceleration/deceleration time constant
Gear 1	5757	5760

Gear 2	5758	5762
Gear 3	5759	5764

(d) Series 15*i*

i) Acc/Dec type

5605 #1

0 : Exponential type

1 : Linear type Acc/Dec (Standard setting)

ii) Set Acc/Dec the time constant of the rigid tapping mode.

D The time constant is a fixed value if bit 2 of parameter No. 5605 = 0.

Acc/Dec time constant	5751
Spindle speed	5757

D When bit 2 of parameter No.5605 is set to 1, one of the four acceleration/deceleration time constants is selected, depending on the spindle speed.

	Spindle speed	Acc/Dec time constant
Gear 1	5886	5884
Gear 2	5889	5887
Gear 3	5892	5890
Gear 4	—	5893

(e) Series 16*i*/16

i) Each parameter can be set for each gear and is selected according to the gear selection signal.

By setting the following parameter, the different time constant between the cutting in and cutting out (extracting) becomes available.

5201 #2

0 : The same time constant between cutting in and out. (NO. 5261 to 5264)

1 : The different time constant between cutting in and out.
Cutting in : NO. 5261 to 5264
Cutting out: NO. 5271 to 5274

Standard Machining [M series]: GR3O, GR2O, GR1O

Turning [T/TT series] and Machining [M series] with surface speed constant : GR2, GR1

Snd. sp of Turning [T/TT series] : GR21
(Multi– spindle control option is needed)

[Standard Machining (M series)]

Gear signal			Time constant (Cutting in) Parameter NO	Time constant (Cutting out) Parameter NO	Spindle max. speed Parameter NO
GR1O	GR2O	GR3O			
1	0	0	5261	5271	5241
0	1	0	5262	5272	5242
0	0	1	5263	5273	5243

[Turning (T/TT series) and Machining (M series) with surface speed constant option]

Gear selection signal			Time constant (Cutting in) Parameter NO	Time constant (Cutting out) Parameter NO	Spindle max. speed Parameter NO	
Fst. sp		Snd. sp				
GR1	GR2	GR21			Turning (T/TTseries)	Machining (M series)
0	0	0	5261	5271	5241	5241
1	0	1	5262	5272	5242	5242
0	1	—	5263	5273	5243	5243
1	1	—	5264 (*1)	5274 (*1)	5244 (*1)	—

(*1) This is not available for Machining (M series).

ii) The override at extracting.

5200 #4

0 : The override at extracting is not valid.
1 : The override at extracting is valid.
(Set override value at No. 5211)

(10)Parameter setting relating to to the motor voltage.

(a) Set ”Motor voltage at servo mode (rigid tapping)”
The setting address is as follows according to CNC type.

The standard setting for this parameter is 30. When the rigid tapping function is to be used, however, set 70 to 100 as the initial value.

If motor excitation is noisy, specify a value of 30 to 70. The parameter addresses for the individual CNCs are listed below.

0 T/M/TT Fst. sp	0 T/TT Snd. sp	15 T/M	15*i*	16*i*/16 T/M/TT	Remarks
6585	6725	3085	3085	4085	Standard motor, High spd.
6901	6941	3281	3137	4137	Low speed range

(b) SetHThe delay time until the motor excitation becomes stableI.

Set the time required to observe the stable motor excitation state after switching to the rigid tapping mode. Set a value from 250 to 400 in the parameter. The parameter addresses for the individual CNCs are listed below.

0 T/M/TT Fst. sp	**0 T/TT Snd. sp**	**15 T/M**	**15*i***	**16*i*/16 T/M/TT**
6599	6739	3099	3099	4099

(11)"Spindle backlash"

(a) In case of Series 0

In the Machining system (M series), the same parameter is applied for all gear.

In the Turning system (T/TT series), each parameter for each gear is set according to the gear selection signal.

Fst. sp : GR2, GR1

Snd. sp : GR21 (Multi–spindle control option is needed)

[Machining (M series)]

Gear signal			**Parameter NO**
GR1O	**GR2O**	**GR3O**	
1	0	0	255
0	1	0	
0	0	1	

[Turning (T/TT series)]

Gear selection signal			**Parameter NO**
Fst. sp		**Snd. sp**	
GR1	**GR2**	**GR21**	
0	0	0	214
1	0	1	215
0	1	—	216
1	1	—	217

(b) In case of Series 15

Set the backlash data according to the following bit paramter.

5604 #2

0 : The same parameter is applied for all gear.
The address is NO. 5756.

1 : Each parameter for each gear is set according to the gear selection signal (CTH1A/B, CTH2A/B) as follows.

Gear signal		**Parameter NO**
CTH1A	**CTH2A**	
0	0	5791
0	1	5792
1	0	5793
1	1	5794

(c) In case of Series 16*i*/16

In the Machining system (M series), the same parameter is applied for all gear.

In the Turning system (T/TT series), each parameter for each gear is set according to the gear selection signal.

Fst. sp : GR2, GR1

Snd. sp : GR21 (Multi–spindle control option is needed)

[Machining]

Gear signal			**Parameter NO**
GR1O	**GR2O**	**GR3O**	
1	0	0	
0	1	0	5321
0	0	1	

[Turning]

Gear selection signal			**Parameter NO**
Fst. sp		**Snd. sp**	
GR1	**GR2**	**GR21**	
0	0	0	5321
1	0	1	5322
0	1	—	5323
1	1	—	5342

2.4.5 Adjustment Procedure

(1) Parameters used for adjustment

The table below lists and describes the parameters used for adjusting rigid tapping.

Parameter No.	Description
5241 to 5244	Maximum spindle speed in rigid tapping (Depends on the GR signal. 5244 is for the T series only.)
5261 to 5264	Acceleration/deceleration time constant in rigid tapping (Depends on the GR signal. 5264 is for the T series only.)
5280 to 5284	Position gain of tapping axis in rigid tapping (5280 is for all gears. 5281 to 5284 depend on the GR signal. 5284 is for T series only.)
4065 to 4068	Spindle position gain in rigid tapping (depends on CTH1 and CTH2 signals)
4044 to 4045	Velocity loop proportional gain in rigid tapping (depends on CTH1 and CTH2 signals)
4052 to 4053	Velocity loop integral gain in rigid tapping (depends on CTH1 and CTH2 signals)
4085	Motor voltage in rigid tapping (for high speed characteristics) Specify 100.
4137	Motor voltage in rigid tapping (for low speed characteristics) Specify 100.
4099	Delay time for motor excitation. Specify a value around 300 to 400.

(2) Observing data used for adjustment

In rigid tapping, adjust the parameters while observing the motor speed, torque command, velocity deviation, synchronization error, and other data by using a spindle check board and oscilloscope. The table below lists spindle check board settings for observing the data.

Check board setting address		Setting	Output signal
Output to CH1	Output to CH2		
d–05	d–09	25	Velocity deviation ±128 min^{-1} at ±5 V ±256 min^{-1} at ±5 V if d–06 (d–10) is set to 13
d–06	d–10	12	
d–07	d–11	0	
d–08	d–12	1	
d–05	d–09	90	Torque command Maximum positive/negative torque command at ±5 V Maximum positive/negative torque command at ±2.5 V if d–06 (d–10) is set to 8
d–06	d–10	7	
d–07	d–11	0	
d–08	d–12	1	
d–05	d–09	68	Synchronization error (value converted for the spindle: 4096 pulses/rev)(*1) ±128 pulses at ±5 V ±256 pulses at ±5 V if d–06 (d–10) is set to 1 ±512 pulses at ±5 V if d–06 (d–10) is set to 2
d–06	d–10	0	
d–07	d–11	0	
d–08	d–12	1	
d–05	d–09	19	Motor speed ±8192 min^{-1} at ±5 V ±4096 min^{-1} at ±5 V if d–06 (d–10) is set to 17 ±2048 min^{-1} at ±5 V if d–06 (d–10) is set to 16
d–06	d–10	18	
d–07	d–11	0	
d–08	d–12	1	

*1 When observing the synchronization error of Series 16i/16, set the following parameters:

No. 3700, #7 = 1 : Uses the synchronization error output (maintenance function).
(Return the setting to 0 after the observation is completed.)

No. 5203, #7 = 1 : Sets a synchronization error update cycle.
(Return the setting to 0 after the observation is completed.)

No. 5204, #0 = 0 : Displays the synchronization error on the diagnosis screen.

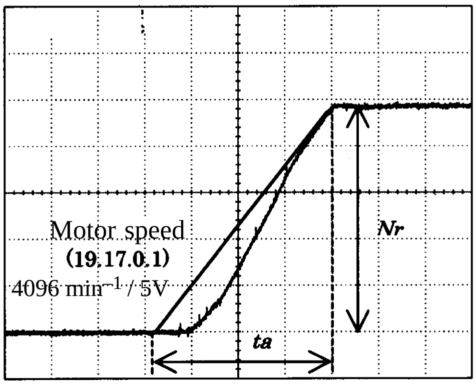
(3) Adjustment procedure

¿¿ Specifying an acceleration/deceleration time constant (1): Specifying a provisional value

Before optimizing the acceleration/deceleration time constant, adjust the gain to improve the response. Following (a) or (b) below, specify a provisional acceleration/deceleration time constant according to the target maximum speed.

(a) Specifying a provisional time constant according to the velocity waveform in actual acceleration/deceleration

Observe the motor velocity waveform (velocity control mode) in acceleration up to the maximum rigid tapping speed. Specify such a provisional time constant that the inclination (acceleration) during rigid tapping acceleration becomes about a half of the inclination of a tangent to the motor velocity waveform near the location of maximum speed. See the sample waveform shown below.



Nr: Maximum rigid tapping speed (Nos. 5241 to 5244)
4000 min^{-1} in this example

ta: Time of acceleration by the maximum torque at *Nr*
About 400 ms in this example

tr: Rigid tapping acceleration/deceleration time constant (Nos. 5261 to 5264)
800 ms, which is two times *ta*, in this example

In this example, the maximum rigid tapping speed Nr is set to 4000 min^{-1}. To determine the acceleration/deceleration time constant, the motor velocity waveform in acceleration up to 4000 min^{-1} is observed. If the acceleration is performed with the maximum motor torque at 4000 min^{-1}, the acceleration time ta needed to attain 4000 min^{-1} is about 400 ms, as shown above. This is the minimum value of acceleration/deceleration time constant tr, which can be specified without consideration of cutting load. A time constant that can be specified in consideration of cutting load is usually about 1.2 to 1.5 times this value. As a provisional value for gain adjustment, approximately double (800 ms) is specified here.

(b) Specifying a value calculated from the relationship between the maximum torque and spindle inertia

Specify an acceleration/deceleration time constant calculated from the following expression:

$$tr[ms] = \frac{Jm[kgm^2] + JL[kgm^2]}{Tmax(Nr)[Nm]} \times \frac{2\pi}{60} \times Nr[min^{-1}] \times GR \times 1000 \times 2$$

tr [ms]	:	Acceleration/deceleration time constant in rigid tapping (Nos. 5261 to 5264)
Nr [min^{-1}]	:	Maximum spindle speed in rigid tapping (Nos. 5241 to 5244)
GR	:	Spindle–motor gear ratio (Motor rotation per spindle rotation)
Tmax (Nr) [Nm]	:	Maximum torque of spindle motor at Nr
Jm [kgm^2]	:	Rotor inertia of spindle motor
JL [kgm^2]	:	Spindle load inertia (converted for the motor shaft)

Specifying a position gain

Specify an initial value of about 2000 (20 sec^{-1}) to 3000 (30 sec^{-1}), then adjust the value as needed. Basically, specify identical values for the spindle and tapping axis.

After specifying the position gain, check whether the spindle is operating as designed. For that purpose, check that the position error (value displayed on the CNC screen) during stable rotation at the maximum speed is almost the same as the theoretical value. This theoretical value is calculated as shown below. If the theoretical value is substantially different, re–check the parameters related to position gain, gear ratio, and detector.

$$\text{Perr(Nr)[pulse]} = \frac{\text{Nr[min}^{-1}]}{60} \times 4096[\text{pulse rev}] \times \frac{1}{\text{PG[sec}^{-1}]}$$

Perr(Nr) [**pulse**]: Position error in stable rotation at **Nr**
Nr [min^{-1}] : Maximum speed in rigid tapping
PG [sec^{-1}] : Position gain in rigid tapping

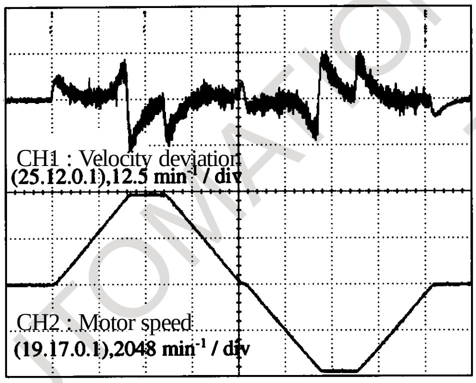
If the gear ratio is 1:1 at **Nr** = 4000 min^{-1} and **PG** = 3000 (30 sec^{-1}), the position error in stable rigid tapping at **Nr** is calculated as follows:

$$\text{Perr(Nr)[pulse]} = \frac{4000}{60} \times 4096 \times \frac{1}{30} = 9102[\text{pulse}]$$

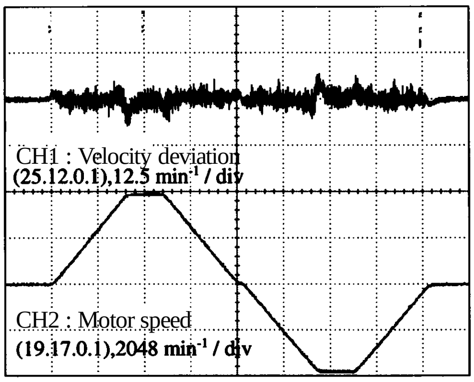
Specifying a velocity loop gain

Specify the maximum velocity loop gain that does not cause the motor at rest to vibrate. Adjust the velocity loop gain so that the velocity deviation decreases. During the adjustment, observe the velocity deviation and motor speed. Sample waveforms before and after the adjustment are shown below:

(a) Waveform before adjustment
(No. 4044 = 10, No. 4052 = 10)



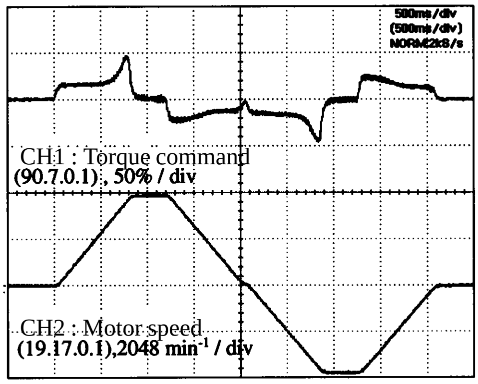
(b) Waveform after adjustment
(No. 4044 = 20, No. 4052 = 60)



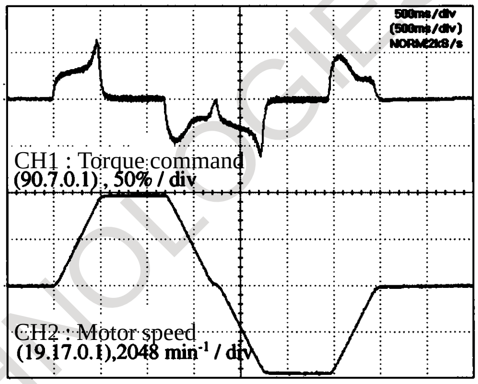
Specifying an acceleration/deceleration time constant (2):
Specifying an optimum value

Observing the torque command and motor speed, make a final adjustment of the time constant. Adjust the time constant in consideration of the actual cutting load, so that the peak torque at air cut becomes about 70% to 80% (3.5 to 4.0 V) of the maximum value. Sample waveforms before and after the adjustment are shown below:

(a) Waveform before adjustment (No. 5261 = 800)



(b) Waveform after adjustment (No. 5261 = 480)



Checking the synchronization error

The spindle adjustment ends when the adjustments described in 4.1 and 4.2 are completed. After the spindle adjustment, check the synchronization error between the spindle and servo axis, which will be an index of rigid tapping precision. The synchronization error is a difference between the spindle position error and the servo axis position error converted for the spindle.

SYNCER [pulse] = PERsp [pulse] – PERsv [pulse]

SYNCER [pulse]	:	Synchronization error (4096 pulses per spindle rotation)
PERsp [pulse]	:	Spindle position error
PERsv [pulse]	:	Servo axis position error converted for the spindle

2.4.6 Diagnosis

(1) In case of Series 0

Diagnosis number		Contents		unit
Machining (M series)	Turning (T series)	Mchining	Turning	
0800	0800	Position error of X axis	Position error of X axis	pulse
0801	0801	Position error of Y axis	Position error of Z axis	pulse
0802		Position error of Z axis		pulse

The contents below is shown in the paramter display.
The parameter address below is used for monitoring.

Parameter number		Contents	unit
Machining (M series)	Turning (T series)		
0627	0435	Position error pulse of the spindle	pulse
0628	0436	Interpolation pulse of the spindle	pulse
0696	0437	Instant value of the position error difference between the tapping axis and the spindle	%
0697	0438	Maximum value of the position error difference between the tapping axis and the spindle	%
0799		Integrated interpolation pulse of the spindle	pulse

(2) Series 15

Address	Contents	unit
3000	Position error pulse of the tapping axis	pulse
	Position error pulse of the spindle	pulse

(3) Series 16*i*/16

Address	Contents	unit
0300	Position error pulse of the tapping axis	pulse
0450	Position error pulse of the spindle	pulse
0451	Interpolation pulse of the spindle	pulse
0454	Integrated interpolation pulse of the spindle	pulse
0455	Difference of move command converted for the spindle (instantaneous)	pulse
0456	Difference of positional deviation converted for the spindle (instantaneous)	pulse
0457	Width of synchronization error	pulse

2.4.7 Alarm

(1) Program error (P/S Alarm)

(a) In case of Series 0, Series 16*i*/ 16

Alarm number	Contents
200	S command is over the range or not inputted.
201	F command is not inputted.
202	The interpolation pulse for the spindle is over the range
203	The commanded place of M29 or S command is not proper.
204	The axis move command is inserted between M29 and G84 (G74) .
205	The rigid mode input signal is not ON during G84 (G74) although M29 is commanded. The rigid mode input signal goes OFF during the rigid tapping.
206	The plane change is commanded during the rigid tapping.

(2) Servo Alarm

(a) In case of Series 0

Alarm number	Contents
4□0 (*1)	The position error of the tapping axis or the spindle at stop exceeds (623) the alarmlevel.
4□1 (*1)	The position error of the tapping axis or the spindle at moving exceeds (621) the alarmlevel.

(*1) □=1, 2, 3 is corresponding to the tapping axis.
In (M series), 1=X, 2=Y, 3=Z, In Turning, 1=X, 2=Z.
These alarms of the spindle are common with the tapping axis.

(b) In case of Series 15

Alarm number	Contents
SV008	The position error of the tapping axis at stop exceeds the alarm level.
SV009	The position error of the tapping axis at moving exceeds the alarm level.
SV31	The position error of the spindle exceeds the alarm level (5757)

(c) In case of Series 15*i*

Alarm number	Contents
SP0231	The position error during spindle rotation is larger than the predetermined value.
SP0232	The position error while the spindle is at rest is larger than the predetermined value.

(d) Series 16*i*/16

Alarm number	Contents
410	The position error of the tapping axis or the spindle at stop exceeds the alarmlevel.(5313)
411	The position error of the tapping axis or the spindle at moving exceeds the alarmlevel.(5311)
740	Position error at rest on the spindle side is larger than the predetermined value (No. 5313).
741	Position error during movement on the spindle side is larger than the predetermined value (No. 5311).

2.5 CS CONTOURING CONTROL

2.5.1 Start–up Procedure

A. Check that the system is ready to start normal operation.

↓

B. Prepare and check the ladder program for the Cs contouring control function. (Refer to the Descriptions (B–65162E).)

↓

C. Set the necessary parameters for Cs contouring control. (See Section 2.5.3.)

↓

D. Check and adjust the waveforms on the Cs contouring control detector.

↓

E. Check the operation of reference position return.

- Direction of return to the reference position in Cs contouring control mode
- Maximum speed in Cs contouring control mode
- Feedrate at which return to the reference position is performed in Cs contouring control mode
- Parameter for the rate of change in the position gain for return to the reference position in Cs contouring control mode

↓

F. Check the stop position when return to the reference position is performed.

- Grid shift in Cs contouring control mode

↓

G. Check the direction of spindle rotation in Cs contouring control mode.

- Parameter specifying the direction of rotation for a positive (+) motion command

↓

H. Adjust and check the Cs contouring control servo system. (Check the operation in jog mode, rapid feed mode, handle mode, and other modes.)

- Position gain in Cs contouring control mode
- Velocity loop proportional gain in Cs contouring control mode
- Velocity integral gain in Cs contouring control mode
- Motor voltage in Cs contouring control mode
- Disturbance torque compensating constant (acceleration feedback gain)
- Spindle speed feedback gain

↓

I. End of operation check in Cs contouring control mode

2.5.2 Spindle Control Signals

(1) Input signal (PMC to CNC)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
G123				CON (M)							COFF (T)
			G027	CON (T/M)							
	G67, 71..	G67, 71..		SCNTR1, 2..							
G229	G227		G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
G230	G226		G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA

(2) Output signal (CNC to PMC)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
F178			F044							FSCSL	
	F67, 71..	F67, 71..		MCNTR1, 2..							
F281	F229		F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
F282	F228		F046					RCFNA	RCHPA	CFINA	CHPA

2.5.3 Parameters

Parameter No.					Description
0T	**0M**	**15**	**15*i***	**16*i*/16**	
3rd axis	4th axis	1804	1804 #7	1023	Specifies the axes subject to Cs contouring control.
0037 #7		1804 #0	–	–	Specify "High–resolution pulse coder is not used." for this parameter.
0037 #3, 2		1815 #1	–	1815 #1	Specify "Separate pulse coder is not used." for this parameter.
0021 #3, 2		1815 #5	–	1815 #5	Specify "Other than absolute–position detector" for this parameter.
–		5609 #1, 0	5609 #0	–	Specifies whether to automatically set a position gain for those axes that are not under Cs contouring control.
6569 to 6572		3069 to 3072	3069 to 3072	4069 to 4072	Position gain for axes subject to Cs contouring control (A parameter is selected by the CTH1A and CTH2A input signals sent from the PMC.)
6780 to 6799		5609 #0 #1	5609 #0	3900 to 3944	Position gain for those axes that are not controlled under Cs contouring control (A parameter is selected by the CTH1A and CTH2A input signals sent from the PMC.)
0102	0103	1820	1820	1820	Specify 2 (= 1 time) for command multiplication.
0065 #1		1005 #0	–	3700 #1	Specifies whether to enable the reference position return function for the first G00 command received after switching to Cs contouring control.
0502	0503	1827	5879	1826	Effective area
0506	0507	1828	5880	1828	Position error limit during movement

Parameter No.					Description
0T	**0M**	**15**	**15*i***	**16*i*/16**	
0595	0596	1829	5881	1829	Position error limit when stopped
–	–	1830	5882	–	Position error limit when the servo system is off
0332	0333	1832	–	1832	Position error limit at feed stop
0520	0521	1420	1420	1420	Rapid feed rate
0561	0562	1423	1423	1423	Jog feedrate
–	–	1422	1422	1422	Maximum cutting feedrate
0635		1622	–	1628	Linear acceleration/deceleration time constant for cutting feed (option)
0524	0525	1620	1620	1620	Linear acceleration/deceleration time constant for rapid feed

Parameter				Description
0	**15**	**15*i***	**16*i*/16**	
6501 #5	3001 #5	3001 #5	4001 #5	Specifies whether to use a high–resolution magnetic pulse coder. (Set 1 in this parameter.)
6501 #6	3001 #6	3001 #6	4001 #6	Specifies use of the Cs contour control position signal for speed detection.
6501 #7	3001 #7	3001 #7	4001 #7	Mounting direction of Cs contour control position detector
6504 #0	3004 #0	3004 #0	4004 #0	Specifies whether to use the high–resolution position coder.
6500 #0	3000 #0	3000 #0	4000 #0	Rotation direction of the spindle and motor
6502 #2, 1, 0	3002 #2, 1, 0	3002 #2, 1, 0	4002 #2, 1, 0	Sets the Cs contouring control resolution. (Normally, set "0, 0, 0.")
6521	3021	3021	4021	Maximum spindle speed in Cs contouring control mode
6500 #3	3000 #3	3000 #3	4000 #3	Direction of reference position return when the system enters Cs contouring control mode for the first time after the power is turned on
6500 #1	3000 #1	3000 #1	4000 #1	Spindle rotation direction for a positive motion command in Cs contouring control mode
6502 #4	3002 #4	3002 #4	4002 #4	Rotation direction signal function in Cs contouring control mode
6516 #4	3016 #4	3016 #4	4016 #4	Setting of the control characteristic for Cs contouring control (Normally, set 0.)
6519 #0	3019 #0	3019 #0	4019 #0	Specifies whether to perform dead zone compensation in Cs contouring control mode.
6546 6547	3046 3047	3046 3047	4046 4047	Proportional gain of the velocity loop in Cs contouring control mode (A parameter is selected by the CTH1A input signal sent from the PMC.)
6554 6555	3054 3055	3054 3055	4054 4055	Integral gain of the velocity loop in Cs contouring control mode (A parameter is selected by the CTH1A input signal sent from the PMC.)
6556 to 6559	3056 to 3059	3056 to 3059	4056 to 4059	Spindle–to–motor gear ratio (A parameter is selected by the CTH1A and CTH2A input signals sent from the PMC.)
6574	3074	3074	4074	Feedrate for reference position return in Cs contouring control mode
6586	3086	3086	4086	Motor voltage in Cs contouring control mode (Normally, set 100.)
6592	3092	3092	4092	Rate of change in the position gain when reference position return is performed in Cs contouring control mode
6594	3094	3094	4094	Disturbance torque compensating constant (acceleration feedback gain)
6597	3097	3097	4097	Spindle speed feedback gain

Parameter				Description
0	15	15*i*	16*i*/16	
6599	3099	3099	4099	Motor excitation delay
6635	3135	3135	4135	Grid shift in Cs contouring control mode

Parameters related to detector when the α sensor Cs contouring control function is used

Parameter				Description
0	15	15*i*	16*i*/16	
6501#6	3001#6	3001#6	4001#6	Setting to use the position signal for Cs contouring control also for speed detection
6501#5	3001#5	3001#5	4001#5	Use of high–resolution magnetic pulse coder (Specify 0.)
6501#2	3001#2	3001#2	4001#2	Use of position coder signal
6503 #7,6,5,4	3003 #7,6,5,4	3003 #7,6,5,4	4003 #7,6,5,4	Position coder signal setting
6503#1	3003#1	3003#1	4003#1	Use of MZ sensor or BZ sensor (Specify 1.)
6504#4	3004#4	3004#4	4004#4	One–rotation signal type
6504#1	3004#1	3004#1	4004#1	Use of separate position detector
6511 #2,1,0	3011 #2,1,0	3011 #2,1,0	4011 #2,1,0	Speed detector type
6518#4	3018#4	3018#4	4018#4	Use of α sensor Cs contouring control function (Specify 1.)
	3719	3355	4355	Amplitude ratio correction data (motor side)
	3720	3356	4356	Phase difference correction data (motor side)
	3721	3357	4357	Amplitude ratio correction data (spindle side)
	3722	3358	4358	Phase difference correction data (spindle side)

2.5.4 Detail of Parameter

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6500	3000	3000	4000					RETRN		ROTA2	ROTA1

ROTA1: Indicates the relationship between the rotation directions of spindle and spindle motor.

0: Rotates the spindle and spindle motor in the same direction.

1: Rotates the spindle and spindle motor in the reverse direction.

ROTA2: Indicates the spindle direction by the move command (+). (Only effective in Cs contouring control)

0: Rotates the spindle in CCW (counter clockwise) direction.

1: Rotates the spindle in CW (clockwise) direction.

RETRN: Indicates the reference point return direction in Cs contouring control.

0: Returns the spindle from the CCW direction to the reference point (counter clockwise direction).

1: Returns the spindle from the CW direction to the reference point (clockwise direction).

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6501	3001	3001	4001	CAXIS3	CAXIS2	CAXIS1					

CAXIS1: Determines whether the high-resolution magnetic pulse coder is used or not.

0: Not used.

1: Used. (Set to 1)

Set to 1 if high–resolution position coder is used.

CAXIS2: Also used in speed detection of the Cs contour control position detection signal.

0: Not used. (when spindle and spindle motor are separated)

1: Used. (in case of built-in spindle motor)

CAXIS3: Indicates the mounting direction of the Cs contour control position detector.

0: Rotates the spindle and position detection in the same direction.

1: Rotates the spindle and position detection in the reverse direction.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6502	3002	3002	4002				CSDRCT		CSDET3	CSDET2	CSDET1

CSDET3-1:

Cs contouring control (resolution) setting.
To be set to 000 usually.
(This parameter is invalid if α sensor Cs contour control is used.)

CSDET3	CSDET2	CSDET1	
0	0	0	360000 p/rev.
0	0	1	180000 p/rev.
0	1	0	120000 p/rev.
0	1	1	90000 p/rev.
1	0	0	60000 p/rev.
1	0	1	40000 p/rev.
1	1	0	20000 p/rev.
1	1	1	10000 p/rev.

CSDRCT:

Setting of the rotation direction signal (SFR/SRV) function when Cs contouring control is used.

0: Rotation direction function enabled
When bit 1 (ROTA2) of parameter No. 4000 is 0

With a + motion command, the spindle rotates counterclockwise when SFR = 1, and the spindle rotates clockwise when SRV = 1.

When bit 1 (ROTA2) of parameter No. 4000 is 1

With a + motion command, the spindle rotates clockwise when SFR=1, and the spindle rotates counterclockwise when SRV=1.

1: Rotation direction function disabled
The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor excitation is available.
When bit 1 (ROTA2) of parameter No. 4000 is 0

With a + motion command, the spindle rotates counterclockwise when SFR = 1 or SRV = 1.

When bit 1 (ROTA2) of parameter No. 4000 is 1

With a + motion command, the spindle rotates clockwise when SFR = 1 or SRV = 1.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6504	3004	3004	4004								HRPC

HRPC: Specifies whether to use high–resolution position coder.

0: Does not use high–resolution position coder.

1: Uses high–resolution position coder.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6516	3016	3016	4016			RFCHK1	CMTVL	FFSMTH			

FFSMTH:

Specifies whether to use the smoothing function under feed forward control.

0: Uses the smoothing function.

1: Does not use the smoothing function.

This bit specifies whether to use the smoothing function under feed forward control in Cs contouring control mode.

CMTVL:

Specifies the control characteristic in Cs contouring control mode.

Normally, set this bit to 0. Check that 100 is specified for the parameter for the motor voltage in Cs contouring control mode (parameter No. 4086).
When a value of less than 100 is to be specified in the motor voltage parameter (No. 4086), set this bit to 1.

RFCHK1:

Specifies whether to use the one–rotation signal error detection (AL–39) function for the detector in Cs contouring control mode.

0: Does not use the one–rotation signal error detection function.

1: Uses the one–rotation signal error detection function.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6519	3019	3019	4019								DTTMCS

DTTMCS:

Specifies whether to apply dead zone compensation in Cs contouring control.

0: Does not apply dead zone compensation.

1: Applies dead zone compensation.

0	15	15*i*	16*i*/16	
6521	3021	3021	4021	Maximum speed in Cs contouring control mode

Data unit : 1 min^{-1} (10 min^{-1} when bit 2 of parameter No.4006 (SPDUNT) is set to 1)

Data range : 0 to 32767

Standard setting : 100

This parameter specifies the maximum speed of a spindle operating in Cs contouring control mode.

When 0 is specified as the parameter for the feedrate for reference position return in Cs contouring control mode (parameter No. 4074), reference position return is performed at the speed specified as the maximum speed in this parameter.

0	15	15*i*	16*i*/16	
6536	3036	3036	4036	Feedforward coefficient

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 0%

Set the feedforward coefficient when feedforward control is executed in servo mode and Cs contouring control.

0	15	15*i*	16*i*/16	
6537	3037	3037	4037	Velocity loop feedforward coefficient

Data unit :

Data range : 0 to 32767

Standard setting : 0

Set the velocity loop feedforward coefficient when feedforward control is executed in servo mode and Cs contouring control.

0	15	15*i*	16*i*/16	
6546	3046	3046	4046	Velocity loop proportion gain in Cs contouring control (HIGH gear) CTH1A=0

Data unit :

Data range : 0 to 32767

6547	3047	3047	4047	Velocity loop proportion gain in Cs contouring control (LOW gear) CTH1A=1

Standard setting : 30

These parameters specify the proportional gains of the velocity loop in Cs contouring control mode.
A parameter is selected by the CTH1A input signal.
Increasing these parameters and the velocity loop integral gain parameters (No. 4054 and up) improves rigidity in Cs contour cutting.
Note that, however, setting too large a value for these parameters will produce oscillation.
The range of values that can be specified varies with the machine system.
Guidelines for setting these parameters are given below.
Generally, the larger the motor, the larger the value that can be specified.
In machines where belts or gears are used as the drive mechanism, belt spring elements or gear backlash, sometimes prevent large values from being specified.

Velocity loop proportional gain = 10 to 50
Velocity loop integral gain = 50 to 500

0	15	15*i*	16*i*/16	
6554	3054	3054	4054	Velocity loop integral gain in Cs contouring control (HIGH gear) CTH1A=0
6555	3055	3055	4055	Velocity loop integral gain in Cs contouring control (LOW gear) CTH1A=1

Data unit :
Data range : 0 to 32767
Standard setting : 50

These parameters specify the integral gains of the velocity loop for Cs contouring control mode.
A parameter is selected by the CTH1A input signal.
Increasing these parameters and the velocity loop proportional gain parameters (No. 4046 and up) improves rigidity in Cs contour cutting.

0	15	15*i*	16*i*/16		
6556	3056	3056	4056	Gear ratio (HIGH)	CTH1A=0, CTH2A=0
6557	3057	3057	4057	Gear ratio (MEDIUM HIGH)	CTH1A=0, CTH2A=1
6558	3058	3058	4058	Gear ratio (MEDIUM LOW)	CTH1A=1, CTH2A=0
6559	3059	3059	4059	Gear ratio (LOW)	CTH1A=1, CTH2A=1

Data unit : Motor rotation for one rotation of spindle × 100
(When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation × 100)
Data range : 0 to 32767
Standard setting : 100

These parameters set the gear ratio of the spindle motor to the spindle.

When the motor rotates 2.5 times for every rotation of the spindle, for example, set 250 in the parameter.
A parameter is selected by the CTH1A and CTH2A input signals.
The gear or clutch status must correspond to the status of the CTH1A and CTH2A input signals.

0	15	15*i*	16*i*/16	
6569	3069	3069	4069	Position gain in Cs contouring control (HIGH) CTH1A=0, CTH2A=0
6570	3070	3070	4070	Position gain in Cs contouring control (MEDIUM HIGH) CTH1A=0, CTH2A=1
6571	3071	3071	4071	Position gain in Cs contouring control (MEDIUM LOW) CTH1A=1, CTH2A=0
6572	3072	3072	4072	Position gain in Cs contouring control (LOW) CTH1A=1, CTH2A=1

Data unit : 0.01 sec $^{-1}$
Data range : 0 to 32767
Standard setting : 3000

These parameters specify the position gains used in Cs contouring control mode.
A parameter is selected by the CTH1A and CTH2A input signals.
Note that the parameter numbers for the position gain of the feed axis in Cs contouring control mode differ from normal parameter numbers. (See Section 2.4.3.)
When a different position gain is to be used for each gear, set an appropriate value in the parameter for each gear.
A parameter is selected by the CTH1A and CTH2A input signals.

0	15	15*i*	16*i*/16	
6574	3074	3074	4074	Speed for return to reference position in Cs contouring control/servo mode

Data unit : 1 min^{-1}

Data range : 0 to 32767

Standard setting : 0

When this parameter is set to 0

In returning to the reference position in Cs contouring control, the feedrate set in the parameter (No. 4021) for specifying the maximum feedrate for Cs contouring control is used. When a high feedrate is used in returning to the reference position, set a desired feedrate in this parameter.

When this parameter is set to a value other than 0

In returning to the reference position in Cs contouring control/servo mode, the spindle feedrate in this parameter is used.

0	15	15*i*	16*i*/16	
6586	3086	3086	4086	Motor voltage setting in Cs contouring control

Data unit : 1%

Data range : 0 to 100

Standard setting : 100

Set the motor voltage to ”100”, when Cs contouring control is in operation.

Set parameter No. 4016 #4 (CMTVL) is ”1”, when the motor voltage during Cs contouring control is set for less than ”100”.

0	15	15*i*	16*i*/16	
6592	3092	3092	4092	The reduction rate of position loop gain in returning to the reference point on Cs contouring mode

Data unit : 1%

Data range : 0 to 100

Standard setting : 100 (100%)

This parameter specifies a rate of change in the position gain used for reference position return in Cs contouring control mode.

When operation is decelerated then stopped, overshoot may occur if return to the reference position is made at high speed or if the spindle inertia is large.

In such a case, decreasing the value of this parameter (to 5 to 50) can suppress the overshoot.

0	15	15*i*	16*i*/16	
6594	3094	3094	4094	The constant of the torque disturbance compensating (Acceleration feedback gain)

Data unit :

Data range : 0 to 32767

Standard setting : 0

This parameter specifies the constant for compensating for a disturbance torque in Cs contouring control mode.
Setting this parameter may improve the cutting stability.
When this parameter is set, the velocity loop proportional gain (parameter No. 4046) can be increased, which may improve the rigidity.
As a guideline, specify 500 to 2000 for this parameter.
Never specify a value of 4000 or more for this parameter.

0	15	15*i*	16*i*/16	
6597	3097	3097	4097	Spindle speed feedback gain

Data unit : 0

Data range : 0 to 32767

Standard setting : 0

This parameter is set to feed back spindle speed and compensate for torque disturbance in Cs contouring control in systems where spindles and spindle motors are linked by gears or belts.
When the spindle and motor are linked by a belt, control stability may be improved by enabling spindle speed feedback.
As a guideline for setting this parameter, specify a value that is almost equal to the velocity loop proportional gain set in parameter No. 4046 (10 to 50).

0	15	15*i*	16*i*/16	
6599	3099	3099	4099	Delay time for motor excitation

Data unit : 1ms

Data range : 0 to 32767

Standard setting : 0

This parameter specifies the time required to achieve stable motor activation in Cs contouring control mode.
When switching to Cs contouring control mode, a stop–time excessive error alarm may be issued intermittently.
This is because an abrupt change in the motor excitation status causes a transient state to be generated in the motor, causing the motor to move very slightly.
If such an alarm is issued, specify this parameter.
Generally, specify about 400 (= 400 msec).

0	15	15*i*	16*i*/16	
6635	3135	3135	4135	Grid shift amount in Cs contouring control

Data unit : Number of pulses (0.001 degrees)
Data range : – 360000 to +360000
Standard setting : 0

Set the pulse from one rotation signal to machine zero point in Cs contouring control.
Specify this parameter when changing the reference position.

Parameters related to detector when using the α sensor Cs contouring control function

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6501	3001	3001	4001		CAXIS2	CAXIS1			POSC2		

POSC2 : Use of position coder signal
Specify 1 (Uses the position coder signal).

CAXIS1 : Use of high–resolution magnetic pulse coder
0: Not used (Specify 0.)
1: Used

CAXIS2 : Use of position signal for Cs contouring control also for speed detection
0: Not used
1: Used
Specify 1 if a built–in motor or motor is connected to the spindle at a ratio of 1:1 and if a separate BZ sensor or α position coder S is not provided on the spindle side.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6503	3003	3003	4003	PCPL2	PCPL1	PCPL0	PCTYPE			PCCNCT	

PCCNCT : Use of MZ sensor or BZ sensor (built–in motor)
Specify 1 (Uses the sensor).

PCPL2, PCPL1, PCPL0, PCTYPE: Position coder signal setting
Specify these bits according to the position detector type.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6504	3004	3004	4004				BISGAN			SPDBIS	

SPDBIS : Use of separate detector
Specify 1 if a separate BZ sensor or α position coder S is connected to the spindle.

BISGAN : One–rotation signal type
Specify 1 to use the α position coder S.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6511	3011	3011	4011						VDT3	VDT2	VDT1

VDT3, VDT2, VDT1: Speed detector type

Specify these bits according to the speed detector type.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6518	3018	3018	4018				ASCS				

ASCS : Use of α sensor Cs contouring control function

Specify 1 (Uses the function).

0	15	15*i*	16*i*/16	
–	3719	3355	4355	Amplitude ratio correction data (motor side)

Data unit :

Data range : -8 to 8

Standard setting : 0

0	15	15*i*	16*i*/16	
–	3720	3356	4356	Phase difference correction data (motor side)

Data unit :

Data range : -4 to 4

Standard setting : 0

0	15	15*i*	16*i*/16	
–	3721	3357	4357	Amplitude ratio correction data (spindle side)

Data unit :

Data range : -8 to 8

Standard setting : 0

0	15	15*i*	16*i*/16	
–	3722	3358	4358	Phase difference correction data (spindle side)

Data unit :

Data range : -4 to 4

Standard setting : 0

2.5.5 Additional Information on Parameters

(1) Time constant for rapid feed along axes subject to Cs contouring control

Parameter No.					Description
0T	0M	15	15*i*	16*i*/16	
0524	0525	1620	–	1620	Linear acceleration/ deceleration time constant for rapid traverse

When rapid feed is performed at high speed, or the spindle inertia is large, overshoot or hunting may occur during acceleration/deceleration in rapid feed.
To prevent this, change the value in the parameter for the linear acceleration/deceleration time constant for rapid feed.

2.5.6 Diagnosis

Address					Description
0T	0M	15	15*i*	16*i*/16	
0802	0803	3000	–	0418	Position error in axis subject to Cs contouring control

2.5.7 Additional Description of Series 0

(1) Axis arrangement in the Cs contouring control mode
The axis for which Cs contouring control is performed is placed as one of the control axes.
The following tables list arrangements of axes.
X, Y, Z : Servo axes
C : Cs contouring control axis

T series

Control axis No.	Axis name	Servo axis No.
1	X	1
2	Z	2
3	C	3
4	4th	4

M series

Control axis No.	Axis name	Servo axis No.
1	X	1
2	Y	2
3	Z	3
4	C	4

(2) Gear selection signals (CTH1A, CTH2A)

The gear selection signals are used to select parameters used in the Cs contouring control mode, such as position gain, gear ratio, and velocity loop gain parameters.

In the T series, four gear stages can be used.

In addition to GR1 and GR2, signals corresponding to clutch/gear signals CTH1A and CTH2A must be applied simultaneously as gear selection signals.

Although GR1 and GR2 are invalid in the Cs contouring control mode, they are valid as usual in the spindle rotation control mode.

With the M series, three gear stages can be used according to the NC specifications.

In addition to GR1O, GR2O, and GR3O, signals corresponding to clutch/gear signals CTH1A and CTH2A must be applied simultaneously as gear selection signals.

Although GR1O, GR2O, and GR3O are invalid in the Cs contouring control mode, they are valid as usual in the spindle rotation control mode.

(3) Position gain in the Cs contouring control mode

In the Cs contouring control mode, the position gains of the Cs contouring control axis and the servo axis for which interpolation with the Cs contouring control axis is performed must be set to the same value.

The parameters for their position gains in the Cs contouring control mode are as follows:

Position gain of the Cs contouring control axis
: Nos. 6569 to 6572

Position gain of the Servo control axis
in the Cs contouring control mode : Nos. 6780 to 6799

These parameters are selected by gear selection signals CTH1A and CTH2A as listed in the following table. After switching to the Cs contouring control mode, the position gains are not changed even if the CTH1A and CTH2A signals are changed. So, before the Cs contouring control mode is entered, the CTH1A and CTH2A signals must be set.

(a) To set the same position gain for the servo axes and Cs contouring control axis in the Cs contouring control mode, set the following parameters.

In this case, set parameter Nos. 6784 to 6799 to 0.

Set parameter Nos. 6780 to 6783 to the same value as parameter Nos. 6569 to 6772.

Gear selection signal		Common to all servo axes	Cs contouring control axis (spindle)
CTH1	CTH2		
0	0	6780	6569
0	1	6781	6570
1	0	6782	6571
1	1	6783	6572

(b) If the position gains of the servo axes and Cs contouring control axis need not be equal, a position gain is specified for each axis in the parameters listed in the following table.

Parameter Nos. 6780 to 6783 which are common to all servo axes must be set to 0.

Gear selection signal		For each axis T series: X axis M series : X axis	For each axis T series : Z axis M series : Y axis	For each axis T series : Cs axis M series : Z axis	For each axis T series : 4th axis M series : Cs axis	Cs contouring control axis (spindle)
CTH1	CTH2					
0	0	6784	6788	6792	6796	6569
0	1	6785	6789	6793	6797	6570
1	0	6786	6790	6794	6798	6571
1	1	6787	6791	6795	6799	6572

(c) The position gains of the servo control axes in the spindle rotation control mode must be set in parameter Nos. 517, and 512 to 515.

(4) Return to the reference position in the Cs contouring control mode

When the machine returns to the reference position in the normal operation mode, the rapid feed is decelerated to the FL speed by the deceleration dog. In the Cs contouring control mode, however, when the reference position return command is input, the one-rotation signal is detected, then the machine returns to the reference position. So no deceleration dog is necessary in the Cs contouring control mode.

(a) Manual return to the reference position (jog mode)

The speed of the reference position return is determined by the parameter for the maximum spindle speed in the Cs contouring control mode (No. 6521).
The direction of reference position return is set in parameter PRM 6500#3.

After switching to the Cs contouring control mode, the reference position return mode is entered by setting the ZRN signal to ON. One of the feed axis selection signals –3 and +3 (for the T series or – 4 and +4 (for the M series) is set to ON. The Cs contouring control axis then moves in the reference position return direction. As the reference position is reached, reference position return completion signal ZP3 (for the T series) or ZP4 (for the M series) is output.

(b) Automatic return to the reference position (AUTO or MDI mode)
The speed of the first reference position return operation performed after switching from the spindle rotation control mode to the Cs contouring control mode is determined by the parameter for the maximum spindle speed in the Cs contouring control mode (No. 6521).
The direction of the reference position return operation is set in parameter PRM 6500#3.
In the Cs contouring control mode, the second and subsequent reference position return operations are performed at the speed set by the parameter.
After switching to the Cs contouring control mode, the machine is returned to the reference position by executing the G00 or G28 command.
Whether the G00 command causes a reference position return operation is determined according to the following parameter. This parameter is valid only for the serial spindle (Cs contouring control axis).

PRM No.65								
							CZRN	

CZRN 1: The first G00 command issued after switching to the Cs contouring control mode does not cause the machine to return to the reference position.

0: The first G00 command issued after switching to the Cs contouring control mode causes the machine to return to the reference position.

G00 command

PRM No. 65 CZRN=0

If the G00 command is executed when reference position return operation has not been performed since switching to the Cs contouring control mode, the machine returns to the reference position.
The reference position is indexed, and at the same time, the spindle is positioned at the specified position.
Only when the spindle is positioned at the reference position (G00 G0.), reference position return completion signal ZP3 (for the T series) or ZP4 (for the M series) is output at the completion of positioning.
When the machine has returned to the reference position, the G00 command performs normal positioning.

PRM No. 65 CZRN=1

If the G00 command is executed when the machine has not returned to the reference position since switching to the Cs contouring control mode, the serial spindle performs normal positioning from its stopped position.

In this case, the reference position is not recognized.
So the G28 command is required to return the machine to the reference position.
When the machine has been returned to the reference position, the G00 command recognizes the reference position. A coordinate system is established, then normal positioning is performed.

G28 command

If G28 is specified after switching to the Cs contouring control mode, the Cs contouring control axis moves to a middle point. Reference position return, then positioning at the reference position are performed. Then, reference position return completion signal ZP3 (for the T series) or ZP4 (for the M series) is output.
When the machine has been returned to the reference position, positioning at the reference position is performed, then reference position return completion signal ZP3 (for the T series) or ZP4 (for the M series) is output.

(c) Operation after switching to the Cs contouring control mode

Immediately after switching from the spindle rotation control mode to the Cs contouring control mode is made, the current position is lost, so it is always necessary to return the machine to the reference position.
If the coordinate system for the Cs contouring control axis is not required, however, a corresponding parameter is set so that the reference position return function is not used. In this case, movement is allowed without returning to the reference position.

(d) Interruption of return to the reference position

Manual operation mode

Reference position return for the Cs contouring control axis can be interrupted by reset, emergency stop, or by turning the axis selection signal to OFF.
In all cases, after the interruption, the reference position return operation must be performed again from the beginning.

Automatic operation mode

The reference position return operation for the Cs contouring control axis can be interrupted by reset, emergency stop or feed hold.
In all cases, after the interruption, reference position return operation must be performed again from the beginning.

(5) Others

(a) Switching between the spindle rotation control and Cs contouring control modes during automatic operation

When switching between the spindle rotation control and Cs contouring control modes is performed during an automatic operation block, if position gains are changed immediately after the mode switch, normal operation is impossible. In this case, confirm the completion of the block, then perform automatic setting.

(b) The functions for memory type pitch error compensation and backlash compensation cannot be used for the Cs contouring control axis.

(c) Before switching to the Cs contouring control mode, signals MRDYA, *ESPA, and SFRA must be set to 1.

(d) When the PMC switches between the spindle rotation control mode and Cs contouring control mode using an M code, the code must not be placed in the same block that contains a move command for the Cs contouring control axis in the NC program. If such an M code and the move command are included together in the same block, alarm PS197 is generated.

(6) Alarm

When the Cs contouring axis control function is used, the following three alarms are added to the conventional alarms:

No.	Description
194	The Cs contouring axis control, Cs axis control, or rigid tapping mode is specified in αseries (Serial) spindle synchronization control mode. (Cancel the synchronization control mode, then specify the command.)
195	A command for switching to the spindle, Cs contouring axis control, or servo mode (such as Cs axis control, or rigid tapping) is specified, but the specified switching operation is not performed by αseries (Serial) spindle.

NOTE

1 Alarm 409 is generated as a servo alarm, and alarms 195 and 194 are generated as P/S alarms. Alarm 194 is not generated when the serial spindle synchronization control option is not provided.

2 During the Cs contouring control mode, for the T series a conventional servo alarm related to the third axis, or for the M series an alarm related to the fourth axis may be generated.

2.5.8 Additional Description of Series 15

(1) Axis arrangement in the Cs contouring control mode

(a) The same number as the control axis number must be set for the servo axis number of the axis for which Cs contouring control is performed. If a different number is set, a servo alarm (SV026) is generated for all axes.

Sample arrangement X, Y, Z : Servo axes
C : Cs contouring control axis

Control axis No.	Axis name	Servo axis No.
1	X	1
2	Y	2
3	Z	3
4	C	4

Set the servo axis number to the same number as the control axis number.

(b) Removal of the control axis in the Cs contouring control mode

If removal of the control axis is specified for the Cs contouring control axis, the spindle enters the spindle rotation control mode. Therefore do not specify removal of the control axis.

(c) Axis arrangement for 15TT

In 15TT, two-spindle control is enabled. If both spindles are used as the Cs contouring control axes, place one Cs contouring control axis on a tool post, and the other axis on another tool post. The two Cs contouring control axes cannot be placed on one tool post.

(2) Gear selection signals and position gain in the Cs contouring control mode

Gear stages 1 to 4 can be used. Stages 5 to 8 cannot be used.

In addition to gear selections signals GS1, GS2, and GS4, clutch/gear signals CTH1A and CTH2A must be applied simultaneously.

The relationships the selected position gain has with the gear selection and clutch/gear signals are listed below.

GS4	GS2	GS1	CTH1A	CTH2A	Position gain parameter for each axis in the Cs contouring control mode (*1)
0	0	0	0	0	3069
0	0	1	0	1	3070
0	1	0	1	0	3071
0	1	1	1	1	3072
1	0	0	Not used		
1	0	1			
1	1	0			
1	1	1			

(*1) When the same position gain as the Cs contouring control axis is set for servo axes other than the Cs contouring control axis in the Cs contouring control mode, set the parameter as follows:

Parameter No.	#7	#6	#5	#4	#3	#2	#1	#0
5609							NGC2	NGC1

NGC1: Specifies whether to set the position gain of the servo axes other than the Cs contouring control axis (1st spindle) to the same value as the position gain of the Cs contouring control axis automatically.

0: Set automatically
1: Not set automatically

If there is no interpolation between the Cs contouring control axis and the other servo axes, or if the same servo loop gain is used, set 1.

NGC2: Specifies whether to set the servo loop gain of the servo axes other than the Cs contouring control axis (2nd spindle for FS15-TT) to the same value as the servo loop gain of the Cs contouring control axis automatically.

0: Set automatically
1: Not set automatically

If there is no interpolation between the Cs contouring control axis and the other servo axes, or if the same servo loop gain is used, set 1.

(3) Automatic position gain setting when switching between the spindle rotation control mode and Cs contouring control mode

(a) Switching from the spindle rotation control mode to Cs contouring control mode

If the servo loop gain of the Cs contouring control axis is different from that of the other servo axes when the modes are switched, linear and circular interpolations with the Cs contouring control axis fail.
To prevent this, at the same time that the modes are switched, the position gain selected by the clutch/gear signals (CTH1A and CTH2A) (PRM 3069, 3070, 3071, 3072) must be set for servo axes other than the Cs contouring control axis automatically. (PRM 5609#1, 0)

(b) Switching from the Cs contouring control mode to spindle rotation control mode

At the same time that the Cs contouring control mode is switched to the spindle rotation control mode, the original position gain (PRM 1825) is set automatically for the servo axes.

(c) Switching between the spindle rotation control and Cs contouring control modes during automatic operation

If mode switching between the spindle rotation control mode and Cs contouring control mode is performed midway through an automatic operation block, the position gain is automatically set after completion of the block is confirmed.

(d) When the gain is not changed

If there is no interpolation between the Cs contouring control axis and other axes, or if the Cs contouring control axis and servo axes have the same position gain, the gain need not be changed. In this case, set the parameter to indicate that gain switching is not performed (PRM 5609#0, #1 = 1).

(e) For FS15-TT

Only the gain of the servo axis of the tool post to which the Cs contouring control axis belongs is changed automatically.

(4) Return to the reference position in the Cs contouring control mode

In normal operation, to return to the reference position, rapid feed is decelerated to the FL speed by the deceleration dog. In the Cs contouring control mode, when the reference position return command is input, the one-rotation signal is detected, then the machine returns to the reference position. So the conventional deceleration dog is unnecessary.

(a) Manual return to the reference position (jog mode)

The speed at which the machine returns to the reference position is determined by the parameter for the maximum spindle speed in the Cs contouring control mode (No. 3021).

The direction for reference position return is set in parameter PRM 3000#3.

After switching to the Cs contouring control mode, the reference position return mode is entered by setting the ZRN signal to ON. One of the feed axis direction selection signals –Jn and +Jn is set to ON. The Cs contouring control axis then moves in the reference position return direction. When the reference position is reached, reference position return completion signal ZPn is output.

(b) Automatic return to the reference position (AUTO or MDI mode)

The speed of the first reference position return operation performed after switching from the spindle rotation control mode to the Cs contouring control mode is determined by the parameter for the maximum spindle speed in the Cs contouring control mode (No. 3021).

The direction of reference position return is set in parameter PRM 3000#3.

In the Cs contouring control mode, the second and subsequent reference position return operations are performed at the speed set by the parameters.

After switching to the Cs contouring control mode, the machine returns to the reference position by executing the G00 or G28 command.

G28 command

If G28 is specified after switching to the Cs contouring control mode, the Cs contouring control axis moves to a middle point. The machine is returned to the reference position, then is positioned at the reference position. Then, reference position return completion signal ZPn is output.
When the machine has returned to the reference position, it is positioned at the reference position then reference position return completion signal ZPn is output.

G00 command

PRM No. 1005 #0=1
(ZRNx: Reference position return function is not provided for each axis.)

If the G00 command is executed when the machine has not returned to the reference position since switching to the Cs contouring control mode, αseries (Serial) spindle performs normal positioning from its stopped position.
In this case, the reference position is not recognized.
So the machine must be returned to the reference position by using the G28 command.
If the G00 command is executed after the machine has returned to the reference position, the reference position is recognized. The coordinate system is established, then normal positioning is performed.

PRM No. 1005 #0=0
(ZRNx: Reference position return function is provided for each axis.)

If the G00 command is executed when the machine has not returned to the reference position since switching to the Cs contouring control mode, the PS alarm is generated.

(c) Operation after switching to the Cs contouring control mode

Immediately after switching from the spindle rotation control mode to the Cs contouring control mode, the current position is lost. Therefore it is necessary to return the machine to the reference position.
If parameter setting indicates that the reference position function is not provided and the coordinate system is not required, however, a move command for the Cs axis can be executed without returning to the reference position.

(d) Interruption of return to the reference position

Manual operation mode

The reference position return operation for the Cs contouring control axis can be interrupted by reset or emergency stop.
In all cases, after the interruption, the reference position return operation must be performed again from the beginning.

Automatic operation mode

The reference position return operation for the Cs contouring control axis can be interrupted by reset or emergency stop.
In all cases, after the interruption, the reference position return operation must be performed again from the beginning.

(5) Others

(a) Switching from the Cs contouring control mode to the spindle rotation control mode

Before changing the modes, be sure to confirm that the motion command for the spindle in automatic or manual operation has terminated.
If the modes are changed while the spindle is moving, an interlock or an excessive positioning deviation alarm may be generated.

(b) Operating monitor

The motor load rating of the spindle and Cs contouring control axis is not set in conventional parameters. It is set in PRM 3127. (In models having motor model code, this parameter is set automatically, so no modification is necessary.)

(c) Remote buffer operation

- Operation with binary statements
- Operation with NC statements. In DNC operation using a remote buffer, setting is made so as to perform high-speed distribution if conditions for high-speed distribution are satisfied (PRM0000#DNC=0).

  Before entering the remote buffer operation mode, cancel the Cs contouring control mode.

  In the remote buffer operation mode, Cs contouring control cannot be performed. Only rotation control is possible.

  In the remote buffer operation mode, switching to the Cs contouring control mode or spindle rotation control mode must not be performed.

  The spindle parameters cannot be rewritten by rewriting programmable parameters.

(d) The functions for memory type pitch error compensation, straightness compensation, gradient compensation, and backlash compensation are invalid for the Cs contouring control axis.

(e) Position coder check for broken wires

The parameter specifying whether to check the position coder for broken wires (PRM 5603#PDC) cannot be used.

To suppress the broken wire check, set a parameter (PRM 5602#NAL) so as to suppress alarm check of the spindle speed control unit. If this parameter is set, alarms of the spindle amplifier are not checked either.

(f) For Cs contouring control, the BMI interface is needed.

(g) FS15-TT spindle

An analog interface spindle and αseries (Serial interface) spindle cannot be used together.

2.6 SPINDLE SYNCHRONIZATION CONTROL

2.6.1 Start–up Procedure

A. Check that normal operation can be performed.

↓

B. Prepare and check the ladder programs for the spindle synchronization function.
(Refer to the Descriptions (B–65162E).)

↓

C. Set the parameters related to spindle synchronization. (See Section 2.6.3.)

↓

D. Connect a position coder and check the feedback signal.

↓

E. Check the spindle synchronous speed.

↓

F. Check the direction of spindle rotation when spindle synchronization is applied.
- Direction of spindle motor rotation when spindle synchronization is applied.

↓

G. Check that errors such as overshoot or hunting do not occur before the spindle achieves the maximum speed for synchronization.
- Position gain for spindle synchronization
- Acceleration/deceleration time constant used for spindle synchronization control

↓

H. Check that the error pulse difference between the spindles is within ±5 pulses.
- Position gain for spindle synchronization
- Spindle–to–motor gear ratio data
- Velocity loop proportional gain for spindle synchronization
- Velocity loop integral gain for spindle synchronization
- Incomplete integration coefficient
- Bell–shaped acceleration/deceleration time constant for spindle synchronization
- Motor voltage for spindle synchronization

↓

I. Check the operation of spindle phase synchronization control.
- Shift amount for spindle phase synchronization
- Compensation data for spindle phase synchronization

↓

J. End the checking of spindle synchronization operation.

2.6.2 DI/DO Signals Related to Spindle Synchronization

(1) Input signals (PMC → CNC)

	0T	0TT	15	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
	G146	G146		G038					SPPHS	SPSYC		
	G124	G124		G032	R081	R071	R061	R051	R041	R031	R021	R011
	G125	G125		G033			SSGN		R121	R111	R101	R091
			G025		R107	R106	R105	R104	R103	R102	R101	R100
			G024		RISGN			R112	R111	R110	R109	R108
			G111		SPPHS	SPSYC						
1st– 2nd–	G229 G233	G229 G1429	G227 G235	G070 G074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
1st– 2nd–	G230 G234	G230 G1430	G226 G234	G071 G075	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA

(2) Output signals (CNC → PMC)

	0T	0TT	15	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
	F178	F178	F245	F044 F049				SYCAL	FSPPH	FSPSY		
			F111		MSPPHS	MSPSYC	SPSYAL					
1st– 2nd–	F281 F285	F281	F229 F245	F045 F049	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
1st– 2nd–	F282 F286	F282	F228 F244	F046 F050					RCFNA	RCHPA	CFINA	CHPA

2.6.3 Parameters Related to Spindle Synchronization

Parameter No.						Description
0T		0TT	15TT		16*i*/16	
1st	2nd		1st	2nd		
0080 #6	–	0080 #6	5820 #0	–	4800 #0	Direction of rotation of the 1st spindle motor while synchronization control is applied
–	0080 #7	0080 #6	–	5820 #1	4800 #1	Direction of rotation of the 2nd spindle motor while synchronization control is applied
0303		0303	5810		4810	Error pulse difference between the two spindles for turning on the spindle phase synchronization completion signal

Parameter No.						Description
0T		0TT	15TT		16*i*/16	
1st	2nd		1st	2nd		
0576		0576	5811		4811	Error pulse difference between the two spindles for issuing an alarm while spindle synchronization is applied
6532	6672	6532	3032	3172	4032	Acceleration/deceleration time constant used for spindle synchronization control (The same value must be set for both the 1st and 2nd spindles.)
6533	6673	6533	3033	3173	4033	Detection level for spindle synchronization completion signal
6534	6674	6534	3034	3174	4034	Shift amount for spindle phase synchronization control
6535	6675	6535	3035	3175	4035	Compensation data for spindle phase synchronization
6544 6545	6684 6685	6544 6545	3044 3045	3184 3185	4044 4045	Velocity loop proportional gain for spindle synchronization (A parameter is selected by the CTH1A PMC DI signal.)
6552 6553	6692 6693	6552 6553	3052 3053	3192 3193	4052 4053	Velocity loop integral gain for spindle synchronization (A parameter is selected by the CTH1A PMC DI signal.)
6506 #1	6646 #1	6506 #1	3006 #1	3146 #1	4006 #1	Gear ratio increment system
6556 to 6559	6696 to 6699	6556 to 6559	3056 to 3059	3196 to 3199	4056 to 4059	Spindle–to–motor gear ratio data (A parameter is selected by the CTH1A and CTH2A PMC DI signals.)
6565 to 6568	6705 to 6708	6565 to 6568	3065 to 3068	3205 to 3208	4065 to 4068	Position gain for spindle synchronization (The same value must be specified for both the 1st and 2nd spindles.) (A parameter is selected by the CTH1A and CTH2A PMC DI signals.)
6506 #4	6646 #4	6506 #4	3006 #4	3146 #4	4006 #4	Setting to disable automatic one–rotation signal detection in spindle synchronization mode switching
6507 #6	6647 #6	6507 #6	3007 #6	3147 #6	4007 #6	Setting of the function for detecting the position coder signal error alarm (AL-47)
6585	6725	6585	3085	3225	4085	Motor voltage for spindle synchronization
6300	6480	6300	3480	3700	4336	Magnetic flux switching point used for calculating an acceleration/deceleration time constant used for spindle synchronization control (The same value must be specified for both the 1st and 2nd spindles.)
6304	6484	6304	3484	3704	4340	Bell–shaped acceleration/deceleration time constant for spindle synchronization (The same value must be specified for both the first and second spindles.)
6310	6490	6310	3490	3710	4346	Incomplete integration coefficient

2.6.4 Parameter Detail for Spindle Synchronization Control

	0	15	15i	16i/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–		6500	3000	4000						POSC1		ROTA1
2nd–		6640	3140									

ROTA1: Indicates the relationship between the rotation directions of spindle and spindle motor.

0: Rotates the spindle and spindle motor in the same direction.

1: Rotates the spindle and spindle motor in the reverse direction.

POSC1: Indicates the mounting direction of position coder.

0: Rotates the spindle and position coder in the same direction.

1: Rotates the spindle and position coder in the reverse direction.

	0	15	15i	16i/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–		6501	3001	4001						POSC2		
2nd–		6641	3141									

POSC2: Determines whether the position coder signal is used or not.

Set this bit to ”1”(Used).

	0	15	15i	16i/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–		6503	3003	4003	PCPL2	PCPL1	PCPL0	PCTYPE				
2nd–		6643	3143									

PCPL2, PCPL1, PCPL0, PCTYPE:
Set a position coder signal.

Set these bits according to the type of detector.
Set these bits to ”0,0,0,0” when using a position coder.

	0	15	15i	16i/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–		6506	3006	4006					SYCREF		GRUNIT	
2nd–		6646	3146									

GRUNIT:

Gear ratio setting resolution setting

0: 1/100 units (Under normal circumstances, set to ”0”.)

1: 1/1000 units

This parameter is used for gear ratio data setting to select whether to set the number of motor revolutions for 1 revolution of the spindle as a multiple of 100 or as a multiple of 1,000.
When the gear ratio is a fraction at 1/100, there may be a constant synchronization error indicated in spindle synchronization control.
In this sort of situation, using setting units of 1/1000 makes the synchronization error appear much smaller.
This parameter changes the following parameter settings.

Parameter No.							Description
Series 0T		0TT	Series 15TT		Series 16*i*/16		
1st	2nd		1st	2nd			
6556 6557 6558 6559	6696 6697 6698 6699	6556 6557 6558 6559	3056 3057 3058 3059	3196 3197 3198 3199	4056 4057 4058 4059		Gear ratio

SYCREF:

Setting for function performing automatic detection of the 1 revolution signal in spindle synchronization control

0: Automatic detection of the 1 revolution signal carried out

1: Automatic detection of the 1 revolution signal not carried out. (When spindle phase synchronization is not carried out)

Each spindle performs an automatic one–rotation signal detection operation to detect the one–rotation signal position when the mode is switched to spindle synchronization mode at power–on. (Each spindle rotates two or three times, even if such rotation is not instructed.)

This operation is required because the one–rotation signal must be detected to enable spindle phase synchronization control.

When this operation results in an error because two spindles are mechanically connected, or synchronous control of the spindle phase is not to be exercised, this operation can be disabled by setting this bit to 1.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–		6507	3007	4007		PCALCH						
2nd–		6647	3147									

PCALCH:

Enables or disables detection of the alarms (AL-41, 42, 47) related to the position coder signal.

0: Detects the alarms related to the position coder signal.

1: Does not detect the alarms related to the position coder signal.

When the spindle is not connected to a position coder on a one–to–one basis, and one or more position coder one–rotation signals are generated during a single rotation of the spindle, the function for detecting the alarms related to the position coder signal does not operate normally, thus resulting in alarm detection errors.

In such a case, set this bit to 1 to disable the alarm function.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–		6516	3016	4016	RFCHK3							
2nd–		6656	3156									

RFCHK3:

Presence of function for redetecting the 1 rotation signal for the position coder signal each time spindle synchronization control mode is entered.

0: The 1 rotation signal is not detected each time the operating mode changes.

Once the 1 rotation signal has been detected, it is not detected again until the power goes off.

1: The 1 rotation signal is detected each time the operating mode changes.

	0	15	16*i*/16	
1st–	6532	3032	4032	Acceleration/decelerationtime constant at spindle synchronization control
2nd–	6672	3172		

Data unit : 1 min^{-1}/sec
(when parameter No. 4006#2 (SPDUNT) = 1, 10 min^{-1})

Data range : 0 to 32767

Standard setting : 0 (0 rpm/sec)

When the synchronization speed command at spindle synchronization control is changed, set the acceleration/deceleration time constant.
When set data is 0, time constant does not function.
Set exactly the same data for 1st spindle and 2nd spindle.

	0	15	16*i*/16	
1st–	6533	3033	4033	Spindle synchronization speed arrival level
2nd–	6673	3173		

Data unit : 1 min^{-1}
(when parameter No. 4006#2 (SPDUNT) = 1, 10 min^{-1})

Data range : 0 to 32767

Standard setting : 10

For the synchronization speed command at spindle synchronization control, if the deviations of the respective spindle motor speeds are within the setting level, the spindle synchronization control complete signal (FSPSY) becomes ”1”.

	0	15	16*i*/16	
1st–	6534	3034	4034	Shift amount at spindle phase synchronization control
2nd–	6674	3174		

Data unit : 1 pulse (360_/4096)

Data range : 0 to 4095

Standard setting : 0

Sets the shift amount from the reference point at spindle phase synchronization control (1 rotation signal).

	0	15	16*i*/16	
1st– 2nd–	6535 6675	3035 3175	4035	Spindle phase synchronization compensation data

Data unit : pulse/2 msec

Data range : 0 to 4095

Standard setting : 10

This parameter reduces speed fluctuations when aligning phase of spindles in spindle phase synchronization control.
When this parameter is "0", since the phase alignment amount is only issued once, the position deviation quickly becomes large, and there are large speed changes on phase alignment.
It is possible to perform smooth phase alignments through issuing separate commands for phase alignment amounts for the number of 2 msec pulses set in this parameter.

	0	15	16*i*/16	
1st– 2nd–	6544 6684	3044 3184	4044	Velocity loop proportion gain on servo mode/on synchronization control (HIGH gear) CTH1A=0
1st– 2nd–	6545 6685	3045 3185	4045	Velocity loop proportion gain on servo mode/on synchronization control (LOW gear) CTH1A=1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This sets velocity loop proportional gain in synchronization control. It is selected HIGH when CTH1A=0 of input signal, and It is selected LOW when CTH1A=1 of input signal.

	0	15	16*i*/16	
1st– 2nd–	6552 6692	3052 3192	4052	Velocity loop integral gain on servo mode/on synchronization control (HIGH gear) CTH1A=0
1st– 2nd–	6553 6693	3053 3193	4053	Velocity loop integral gain on servo mode/on synchronization control (LOW gear) CTH1A=1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This sets velocity loop integral gain in synchronization control. It is selected HIGH when CTH1A=0 of input signal, and It is selected LOW when CTH1A=1 of input signal.

	0	15	16i/16	
1st– 2nd–	6556 6696	3056 3196	4056	Gear ratio (HIGH) CTH1A=0, CTH2A=0
1st– 2nd–	6557 6697	3057 3197	4057	Gear ratio (MEDIUM HIGH) CTH1A=0, CTH2A=1
1st– 2nd–	6558 6698	3058 3198	4058	Gear ratio (MEDIUM LOW) CTH1A=1, CTH2A=0
1st– 2nd–	6559 6699	3059 3199	4059	Gear ratio (LOW) CTH1A=1, CTH2A=1

Data unit : Motor rotation for one rotation of spindle × 100 (When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation × 1000)

Data range : 0 to 32767

Standard setting : 100

These parameters set the gear ratio of the spindle motor to the spindle. When the motor rotates 2.5 times for each turn of the spindle, for example, set 250 in the parameter.
A parameter is selected by the CTH1A and CTH2A input signals.
The gear or clutch status must correspond to the status of the CTH1A and CTH2A input signals.

	0	15	16i/16	
1st– 2nd–	6565 6705	3065 3205	4065	Position gain on servo mode/on synchronization control (HIGH) CTH1A=0, CTH2A=0
1st– 2nd–	6566 6706	3066 3206	4066	Position gain on servo mode/on synchronization control (MEDIUM HIGH) CTH1A=0, CTH2A=1
1st– 2nd–	6567 6707	3067 3207	4067	Position gain on servo mode/on synchronization control (MEDIUM LOW) CTH1A=1, CTH2A=0
1st– 2nd–	6568 6708	3068 3208	4068	Position gain on servo mode/on synchronization control (LOW) CTH1A=1, CTH2A=1

Data unit : 0.01 sec^{-1}

Data range : 0 to 32767

Standard setting : 1000

This sets position gain in synchronization control. It is selected by CTH1A or CTH2A of input signal.

	0	15	16i/16	
1st– 2nd–	6585 6725	3085 3225	4085	Motor voltage setting on servo mode/on synchronization control

Data unit : 1%

Data range : 0 to 100

Standard setting : Varies with the motor model.

Set a motor voltage for spindle synchronization.

	0	15	16*i*/16	
1st–	6300	3480	4336	Magnetic flux switching point used for calculating an acceleration/ deceleration time constant used for synchronous control of the spindle
2nd–	6480	3700		

Data unit : 1 min^{-1}
(10 min^{-1} when bit 2 (SPDUNT) of parameter No. 4006 is set to 1)

Data range : 0 to 32767

Standard setting : 0

Set a speed for switching the acceleration/deceleration time constant used for spindle synchronization control.
In the area below the speed set in this parameter, acceleration/deceleration is performed according to the time constant set in parameter No. 4032 (acceleration/deceleration time constant at spindle synchronization control). In the area above the speed set in this parameter, the time constant varies according to the torque characteristics.
When 0 is set in this parameter, linear acceleration/deceleration is performed.
The same value must be specified in this parameter for the first spindle and second spindle.

	0	15	16*i*/16	
1st–	6304	3484	4340	Bell–shaped acceleration/deceleration time constant for spindle synchronization
2nd–	6484	3704		

Data unit : 1 msec

Data range : 0 to 512

Standard setting : 0

Set a bell–shaped acceleration/deceleration time constant used when the specified synchronous speed for spindle synchronization is changed.
This parameter is applied to a move command after the acceleration/ deceleration time constant at spindle synchronization control set in parameter No. 4032 is applied. Consequently, linear acceleration/ deceleration is performed according to the time constant set in this parameter when 0 is set in parameter No. 4032.
When this parameter is set, the spindle synchronous speed control completion signal (FSPSY), output when the synchronous speed is first reached after the spindle synchronization mode is entered, is delayed by the set time.
The same value must be specified, using this parameter, for both the 1st and 2nd spindles.

	0	15	16*i*/16	
1st–	6310	3490	4346	Incomplete integration coefficient
2nd–	6490	3710		

Data unit :

Data range : 0 to 32767

Standard setting : 0

Set this parameter to use incomplete integration for velocity loop integration control.

2.6.5 Number of Error Pulses in Spindle Synchronization

(1) Calculating the number of error pulses in spindle synchronization

$$\text{Error pulses [p]} = \frac{\text{spindle synchronous speed [min}^{-1}]}{60 \text{ [sec]}} \times 4096 \text{ [p rev]} \times \frac{1}{\text{position gain [sec}^{-1}]}$$

Example : When spindle synchronous speed = 1000 min^{-1}, and position gain = 20 sec^{-1}

$$\text{Error pulses} = \frac{1000}{60} \times 4096 \times \frac{1}{20} = \text{About } 3,413 \text{ pulses}$$

(2) Checking the number of error pulses in spindle synchronization

If the number of error pulses in spindle synchronization checked by diagnosis differs greatly from the calculated value, check the following:

- Spindle speed (This can be checked using the SACT indication of the CNC.)
- Spindle–to–motor gear ratio parameters (Nos. 4056 to 4059)
  (The actual gear ratio can be checked from the spindle speed, above, and the motor speed indication given on the spindle check board.)
- Position gain parameters (Nos. 4065 to 4068)
- How the gear selection signals (CTH1A, CTH2A) are used for selection (This can be checked by diagnosis.)

If the number of error pulses differs by several pulses in steady–state rotation, the increment system of the spindle–to–motor gear ratio parameters may be 1/100, and the method used for discarding insignificant digits may be the cause.

In such a case, change the increment system for the gear ratio parameters to 1/1000 (by setting bit 1 of parameter No. 4006 to 1) so that the gear ratio data can be set in increments of 1/1000.

2.6.6 Specifying a Shift Amount for Spindle Phase Synchronization Control

The following describes an example of determining the shift amount for phase synchronization in synchronous control of the spindle phase.

1. Apply synchronous control of the spindle phase by setting the following:
   - SFR = 1 (SRV = 1) for the 1st and 2nd spindles
     : M03
   - Spindle synchronous speed command = 0 rpm
     : S0
   - For the 1st and 2nd spindles, set 0 in the parameter for the shift amount for spindle phase synchronization control.
2. After establishing spindle phase synchronization, set SFR for the 2nd spindle to 0 (to deactivate the motor).

   The 2nd spindle must be rotated manually because the power to its motor is turned off.
3. Manually rotate the 2nd spindle to the next position where spindle phase synchronization is to be established.

   On the diagnosis screen indicating the number of error pulses between the two spindles, check the number of error pulses output between the first position where spindle phase synchronization was established to the next position where spindle phase synchronization is to be established.
   This value serves as data to be set in the parameter for the shift amount used for spindle phase synchronization.
4. Set the number of pulses, determined as above, in the parameter for specifying a shift amount for spindle phase synchronization for the 2nd spindle.

   In general, set 0 in the parameter for the shift amount for spindle phase synchronization for the 1st spindle.
5. After cancelling the spindle synchronization command, perform another spindle phase synchronization operation, according to the following settings, to check that phase synchronization has been established as expected:
   - SFR = 1 (SRV = 1) for the 1st and 2nd spindles
     : M03
   - Spindle synchronous speed command = 0 min^{-1}
     : S0

2.6.7 Diagnosis

Address				Description
0T	0TT	15TT	16*i*/16	
–		1508	–	Spindle synchronization sequence state
0754		1509	0414	Number of error pulses output for 1st spindle in spindle synchronization
0755		1510	0415	Number of error pulses output for 2nd spindle in spindle synchronization
0756		1511	0416	Error pulse difference between the spindles in spindle synchronization

2.6.8 Additional Explanations of Series 0–TC

(1) Synchronization control of spindle phase is executed when the signal for controlling spindle phase in synchronization is entered in spindle synchronization control mode (after output of the signal indicating that synchronization control of spindle speed is completed). The signal indicating that synchronization control of spindle phase is completed is output when the difference between the error pulses of the two spindles does not exceed the number of pulses specified in parameter 303 of the NC function. The two spindles are not synchronized when synchronization control of spindle phase is in progress (until the signal indicating that the synchronization control of spindle phase is completed is set to 1). The command for spindle phase synchronization must not be issued while a workpiece is being held with the two spindles. If it is issued, synchronization control of spindle phase is started automatically.

(2) PMC signal, SYCAL is provided to monitor synchronization errors between spindles for which spindle synchronization control or synchronization control of spindle phase is in effect. The synchronization error between the two spindles is always monitored. The SYCAL signal is set to 1 when the error (the absolute value of the error pulse) specified in parameter 576 of the 1st spindle is exceeded, and set to 0 when not exceeded.

(3) Like the conventional spindle speed (S) command for which 4 or 5 digits are issued for the 1st spindle, the signal for specifying spindle speed can be generated when spindle synchronization control or synchronization control of spindle phase are in the process of being put into effect. The SIND, SSIN, SSGN, R01I to R12I, *SSTP, and SOR signals are effective as usual. The maximum speed in synchronization control is determined by the maximum speed set for the motor of the 1st spindle (parameter 6520).

[Example] Maximum speed of the motor of the 1st spindle
: 6000 min^{-1}
Maximum speed of the motor of the 2nd spindle
: 4500 min^{-1}

However, the maximum speed during synchronization control is limited by the maximum speed of the 2nd spindle motor. In the example above, the maximum speed that can be specified by the 12-bit speed command is 6000 min^{-1} for the 1st spindle. However, if 6000 min^{-1} is specified in synchronization control, an overspeed alarm is issued from the 2nd spindle. The spindle speed specified by the command must not exceed 4500 min^{-1}.

(4) The S command for the 1st spindle and the PMC control signal for spindle control become effective when issued before spindle synchronization control or synchronization control of spindle phase are put into effect. The S command issued in synchronization control becomes effective for the 1st spindle immediately after synchronization control is canceled.

(5) In the usual mode of spindle rotation control, spindle speed can be controlled by the PMC function when the following conditions are satisfied: The SIND signal is set to 1 and the SSIN, SSGN, and R01I to R12I signals are provided. When spindle synchronization control is in the process of being put into effect, something other than the R01I to R12I signals is required to control the spindle speed in synchronization. The maximum spindle gear speed must be properly set in parameters 540, 541, 542, and 543. When the value set in the parameter corresponding to the selected gear is 0, the rotations of the spindles are not synchronized even if a command is entered in the 12-bit signal of the SIND signal.

(6) The load may change due to cutting (or threading). When the load changes in spindle synchronization control, the spindle speed may change and the signal indicating that the synchronization control of spindle speed is completed may go off temporarily.

(7) Parameters PRM 0080, #6 and #7 are used to set the direction of rotation of the 1st spindle and 2nd spindle, respectively.

Parameter PRM 0080 #6 or #7=”0”	Counterclockwise (CCW)
Parameter PRM 0080 #6 or #7=”1”	Clockwise (CW)

(8) The gear ratio of the spindle to the position coder must be set to one-to-one.

(9) In spindle synchronization control, the compensation value for spindle speed offset (parameter 516) is disabled.

(10) Alarm

The following alarm may be issued in spindle synchronization control.

P/S alarm

Alarm number	Description
194	A command for Cs contouring control, spindle indexing, or rigid tapping was issued in spindle synchronization control.

2.6.9 Additional Explanations of Series 0–TT

(1) Synchronization control of spindle phase is executed when the signal for controlling the spindle phases in synchronization is entered in spindle synchronization control mode (after output of the signal indicating that the synchronization control of spindle speed has been completed).
The signal indicating that the synchronization control of spindle

phase is completed is output when the difference between the error pulses of the two spindles does not exceed the number of pulses specified in parameter 303 of the NC function.
The positions of spindle phase synchronization for both spindles one and two can be specified in spindle parameter 6534.
The two spindles are not synchronized when synchronization control of spindle phase is in progress (until the signal indicating that the synchronization control of spindle phase is completed is set to 1).
The command for spindle phase synchronization must not be issued while a workpiece is being held with the two spindles.
If it is issued, synchronization control of spindle phase is started automatically.

(2) PMC signal, SYCAL is provided to monitor a synchronization errors between spindles for which spindle synchronization control or synchronization control of spindle phase is in effect. The synchronization error between the two spindles is always monitored. The SYCAL signal is set to 1 when the error (the absolute value of the error pulse) specified in parameter 576 of tool post one is exceeded, and set to 0 when not exceeded.

(3) When generated while spindle synchronization control or synchronization control of spindle phase is in the process of being put into effect, the signal specifying the speed is used as the signal for specifying the synchronization speed.
The signal depends on information specified at addresses G124 and G125 by PMC. 0TTC cannot use the four or five digit spindle speed (S) command.
However, it can use the function of the 4 or 5 digit S command via PMC by using the S 12-bit information output at addresses F172 and F173.
With this function, constant surface speed control can be executed in synchronization control even while a workpiece is being held with the two spindles.
However, the time constant specified in the parameter is not exceeded even if a larger speed increment is specified.

(4) The maximum speed in synchronization control is determined by the maximum speed of the spindle motor of HEAD 1 (parameter 6520).

[Example] Maximum speed of the spindle motor of HEAD 1
: 6000 min^{-1}
Maximum speed of the spindle motor of HEAD 2
: 4500 min^{-1}

However the maximum speed during synchronization control is limited by the maximum speed of HEAD 2. In the example above, the maximum speed that can be specified by the 12-bit speed command is 6000 min^{-1} for HEAD 1. However, if 6000 min^{-1} is specified in synchronization control, an overspeed alarm is issued from HEAD 2.
The spindle speed specified by the command must not exceed 4500 min^{-1}.

(5) When the spindles are controlled by PMC in the usual spindle control mode, the SIND signal needs to be set to 1. In synchronization control mode, the spindles are controlled according to the synchronization speed specified by the SSGN and R01I to R12I signals. Control does not depend on the states of the usual spindle control signals, *SSTP, SOR, SIND, and SSIN.
However, settings other than signals R01I to R12I are required to specify synchronization of spindle speed.
The maximum spindle gear speed must be properly set in parameters

540, 541, 542, and 543 of tool post 1.
When the value set in the parameter corresponding to the selected gear is 0, the rotations of the spindles are not synchronized even if a command is entered in the 12-bit signal of the SIND signal.

(6) The load may change due to cutting (or threading). When the load changes in spindle synchronization control, the spindle speed may change and the signal indicating that the synchronization control of spindle speed is completed may go off temporarily.

(7) Parameter PRM 0080, #6 is used to set the direction of rotation of the 1st and 2nd spindles.

Parameter PRM 0080 #6=”0”	Counterclockwise (CCW)
Parameter PRM 0080 #6=”1”	Clockwise (CW)

(8) The gear ratio of the spindle to the position coder must be set to one-to-one.

(9) In spindle synchronization control, the compensation value for the spindle speed offset (parameter 516) is disabled.

(10)The command for spindle phase synchronization is effective only in spindle synchronization control mode.

(11) Alarm

The following alarm may be issued in spindle synchronization control.

P/S alarm

Alarm number	Description
194	A command for Cs contouring control, spindle indexing, or rigid tapping was issued in spindle synchronization control.

2.6.10 Additional Explanations of Series 15–TT

(1) The BMI interface needs to be used when this function is used. (This function cannot be used with the FS3/6 interface.)

(2) Synchronization control of spindle phase is executed when the signal for controlling the spindle phases in synchronization is entered in spindle synchronization control mode (after output of the signal indicating that synchronization control of spindle speed is in effect). The signal indicating that synchronization control of spindle phase is completed is output when the difference between the error pulses of the two spindles does not exceed the number of pulses specified in parameter 5810 of the NC function.
The positions of spindle phase synchronization for spindles one and two can be specified in spindle parameters 3034 and 3174, respectively.
The two spindles are not synchronized when synchronization control of spindle phase is in progress (until the signal indicating that synchronization control of spindle phase is completed is set to 1). The command for spindle phase synchronization must not be issued while a workpiece is being held with the two spindles.
If issued, synchronous control of spindle phase is started automatically.

(3) PMC signal, SPSYAL is provided to monitor the synchronization error between spindles for which spindle synchronization control or synchronization control of spindle phase is in effect. The synchronization error between the two spindles is always monitored. The SPSYAL signal is set to 1 when the error (the absolute value of the error pulse) specified in parameter 5811 of the 1st spindle is exceeded, and set to 0 when not exceeded.

(4) When generated while spindle synchronization control or synchronization control of spindle phase is in the process of being put into effect, the signal specifying speed is used as the signal for specifying the synchronization speed.
The signal for specifying the spindle speed can be generated like the conventional spindle motor command which sends a voltage signal. Signals RISGN and RI00 to RI12 are effective as usual.
The maximum spindle speed in synchronization control is determined by the maximum speed of the motor of the 1st spindle (parameter 3020).
[Example] Maximum speed of the motor of the 1st spindle
: 6000 min^{-1}
Maximum speed of the motor of the 2nd spindle
: 4500 min^{-1}
However, maximum speed in synchronization control is limited by the maximum speed of the 2nd spindle. In the example above, the maximum speed that can be specified by the 13-bit speed command is 6000 min^{-1} for the 1st spindle.
However, if 6000 min^{-1} is specified in synchronization control, an overspeed alarm is issued from the 2nd spindle. The spindle speed specified by the command must not exceed 4500 min^{-1}.

(5) The command for spindle phase synchronization is effective only in spindle synchronization control mode.

(6) The load may change due to cutting (or threading). When the load changes in spindle synchronization control, the spindle speed may change and the signal indicating that synchronization control of spindle speed is completed may go off temporarily.

(7) Bit 0 and 1 of parameter PRM 5820 are used to set the direction of rotation of the 1st spindle and 2nd spindle respectively.

Parameter PRM 5820 #0 or #1=”0”	Counterclockwise (CCW)
Parameter PRM 5820 #0 or #1=”1”	Clockwise (CW)

(8) The gear ratio of the spindle to the position coder can be set only to one to one.
Identical gear ratios must be set for the 1st and 2nd spindles. (Parameters 5610 and 5660)

(9) Sequence state in spindle synchronization control

	#7	#6	#5	#4	#3	#2	#1	#0
1508					SPSYC3	SPSYC2	SPSYC1	SPSYC0

SP SYC3	SP SYC2	SP SYC1	SP SYC0	Internal processing state
0	0	0	0	The spindles are not in spindle synchronization control mode. (SPSYC = 1 is waited.)
0	0	0	1	Waits for the signal that indicates that synchronization speed has been reached to be generated. (Synchronization control of spindle speed is in progress.)
0	0	1	0	Waits for the signal that indicates that synchronization speed has been reached to be set.
0	0	1	1	Waits for the signal that indicates that synchronization control of spindle speed is completed and the command for spindle phase synchronization to be generated. (Waits for SPPHS = 1.)
0	1	0	0	Phase synchronization, on/off
0	1	0	1	Waits for the signal that indicates that synchronization speed has been reached to be cleared. (Synchronization control of spindle phase is in progress.)
0	1	1	0	Waits for the signal that indicates that synchronization speed has been reached to be set.
0	1	1	1	Synchronization control of spindle phase is in effect.

2.7 SPEED RANGE SWITCHING CONTROL

2.7.1 Start–up Procedure

A. Check that normal operation can be performed.

↓

B. Check the connections for speed range switching control.

↓

C. Prepare and check the ladder programs for speed range switching control.

↓

D. Set the parameters related to speed range switching control.

↓

E. Check the speed range switching control operation.

NG

2.7.2 Signals Related to Spindle Speed Control

(1) Input signals (PMC → CNC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	G229 G233	G227 G235	G227 G235	G070 G074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
1st– 2nd–	G230 G234	G226 G234	G226 G234	G071 G075	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
1st– 2nd–	G231 G235	G229 G237	G229 G237	G072 G076	RCHHGA	MFNHGA	INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA

(2) Output signals (CNC → PMC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	F281 F285	F229 F245	F229 F245	F045 F049	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
1st– 2nd–	F282 F286	F228 F244	F228 F244	F046 F050					RCFNA	RCHPA	CFINA	CHPA

2.7.3 Related Parameters

Parameter No.				Description
0	15	15*i*	16*i*/16	
6515 #2	3015 #2	3015 #2	4015 #2	Whether to use the speed range switching control function. (Set this bit to 1.) (The CNC software option is required.)
6514 #3	3014 #3	3014 #3	4014 #3	Function for checking the high–speed and low–speed characteristics of the contacts of electromagnetic contactors in speed range switching
6519 #4	3019 #4	3019 #4	4019 #4	Function for checking the speed detection signal output when switching from the high–speed characteristics to low–speed characteristics
6523	3023	3023	4023	Speed detection level
6924	3304	3160	4160	Speed detection level hysteresis

2.7.4 Detail of Parameter

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6514	3014	3015	4014					CHGSLT			
2nd–	6654	3154										

CHGSLT:

Specifies whether to check the contacts of the high and low magnetic contractors for speed range switching.

0: Makes a check by using the power line status check signal (RCH).

1: Checks the contacts of the high and low magnetic contactors.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6515	3015	3014	4015						SPDSW		
2nd–	6655	3155										

SPDSW: Presence of speed range switching function (CNC software option)

0: Without speed range switching function

1: With speed range switching function (Set to 1.)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6519	3019	3019	4019				SDTCHG				
2nd–	6659	3159										

Standard setting: 0 0 0 0 0 0 0 0

SDTCHG:

Specifies whether to switch from the high-speed to low-speed range in speed range switching at the speed detection level (SDT = 1) or lower

0: Switches from the high-speed to low-speed range regardless of the speed detection signal (SDT).

1: Switches from the high-speed to low-speed range at the speed detection signal SDT = 1.

When this bit is set to 0, switching from the high–speed to low–speed characteristics is performed, regardless of the state of the speed detection signal (SDT).

When this bit is set to 1, switching from the high–speed to low–speed characteristics is not performed if the speed detection signal (SDT) is set to 0; switching takes place once the speed detection signal (SDT) is set to 1.

To ensure that switching to the low–speed characteristics is performed near the switching speed, set a speed detection level (in parameter No. 4023) that is slightly higher then the switching speed level.

	0	15	15*i*	16*i*/16	
1st–	6523	3023	3023	4023	Speed detecting level
2nd–	6663	3163			

Data unit : 0.1%

Data range : 0 to 1000 (0 to 100%)

Standard setting : 0

This data is used to set the detecting range of speed detecting signal (SDT).

When the motor speed reaches (setting data/10) % or less of maximum speed, the bit of speed arrival signal (SDT) is set to ”1”.

	0	15	15*i*	16*i*/16	
1st–	6924	3304	3160	4160	Speed detection level hysteresis
2nd–	6964	3524			

Data unit : 1 min^{-1}
(when parameter No. 4006 #2 (SPDUNT) = 1, 10 min^{-1})

Data range : 0 to 32767

Standard setting : 0

Set the detection level hysteresis of the speed detection signal (SDTA). The state of the speed detection signal (SDTA) changes from 1 to 0 at a motor speed of (detection level + hysteresis), and from 0 to 1 at a specified (detection level).

When 20 min^{-1} or less is set in this parameter, a hysteresis of 20 min^{-1} is set automatically.

When the speed detection signal (SDTA) is used for speed range switching control, set a greater value if the switching circuitry causes chattering near the speed detection level.
Measure the speed variation at switching, then set a value obtained by adding a margin (about twice the measured value) to the measured value as a hysteresis.
The hysteresis can be calculated by using the formula below as a guideline (assuming that the motor load torque at the time of switching is 20% of the maximum output torque).

$$\text{Hysteresis }[\text{min}^{-1}] = \frac{\text{speed range switching time}}{\text{acceleration time until maximum speed is reached}} \times \text{maximum speed} \times 0.2$$

2.7.5 Parameter Switching Between High–speed Range and Low–speed Range

(1) Gear/clutch signals (CTH1A, CTH2A)

For switching of the velocity loop gain, position gain, and gear ratio data between the high–speed and low–speed characteristics in speed range switching control, the gear/clutch signals (input signals), CTH1A and CTH2A, are used.
Usually, the gear/clutch signals are used to select the spindle parameters (velocity loop gain, position gain, and gear ratio) for a selected gear/clutch.
For speed range switching control, set CTH1A and CTH2 together with the winding selection.

CTH1A	CTH2A	Gear/clutch selection state	Winding selection state
0	0	HIGH GEAR (HIGH)	Windings for high–speed power characteristics
0	1	MEDIUM HIGH GEAR (HIGH)	––
1	0	MEDIUM LOW GEAR (LOW)	––
1	1	LOW GEAR (LOW)	Windings for low–speed power characteristics

(2) Relationships between the gear/clutch signals and spindle parameters

(a) When the windings for high–speed power characteristics are selected (CTH1A = 0, CTH2A = 0)

	0	15	15*i*	16*i*/16	
1st–	6540	3040	3040	4040	Velocity loop proportional gain on normal operation (HIGH gear)
2nd–	6680	3180			
1st–	6542	3042	3042	4042	Velocity loop proportional gain on orientation (HIGH gear)
2nd–	6682	3182			
1st–	6544	3044	3044	4044	Velocity loop proportional gain on servo mode (HIGH gear)
2nd–	6684	3184			
1st–	6546	3046	3046	4046	Velocity loop proportional gain in Cs contouring control (HIGH gear)
2nd–	6686	3186			
1st–	6548	3048	3048	4048	Velocity loop integral gain on normal operation (HIGH gear)
2nd–	6688	3188			

	0	15	15*i*	16*i*/16	
1st–	6550	3050	3050	4050	Velocity loop integral gain on orientation (HIGH gear)
2nd–	6690	3190			
1st–	6552	3052	3052	4052	Velocity loop integral gain on servo mode (HIGH gear)
2nd–	6692	3192			
1st–	6554	3054	3054	4054	Velocity loop integral gain in Cs contouring control (HIGH gear)
2nd–	6694	3194			
1st–	6560	3060	3060	4060	Position gain on orientation (HIGH gear)
2nd–	6700	3200			
1st–	6565	3065	3065	4065	Position gain on servo mode (HIGH gear)
2nd–	6705	3205			
1st–	6569	3069	3069	4069	Position gain in Cs contouring control (HIGH gear)
2nd–	6709	3209			

(b) When the windings for low–speed power characteristics are selected (CTH1A = 1, CTH2A = 1)

	0	15	15*i*	16*i*/16	
1st–	6541	3041	3041	4041	Velocity loop proportional gain on normal operation (LOW gear)
2nd–	6681	3181			
1st–	6543	3043	3043	4043	Velocity loop proportional gain on orientation (LOW gear)
2nd–	6683	3183			
1st–	6545	3045	3045	4045	Velocity loop proportional gain on servo mode (LOW gear)
2nd–	6685	3185			
1st–	6547	3047	3047	4047	Velocity loop proportional gain in Cs contouring control (LOW gear)
2nd–	6687	3187			
1st–	6549	3049	3049	4049	Velocity loop integral gain on normal operation (LOW gear)
2nd–	6689	3189			
1st–	6551	3051	3051	4051	Velocity loop integral gain on orientation (LOW gear)
2nd–	6691	3191			
1st–	6553	3053	3053	4053	Velocity loop integral gain on servo mode (LOW gear)
2nd–	6693	3193			
1st–	6555	3055	3055	4055	Velocity loop integral gain in Cs contouring control (LOW gear)
2nd–	6695	3195			
1st–	6563	3063	3063	4063	Position gain on orientation (LOW gear)
2nd–	6703	3203			
1st–	6568	3068	3068	4068	Position gain on servo mode (LOW gear)
2nd–	6708	3208			
1st–	6572	3072	3072	4072	Position gain in Cs contouring control (LOW gear)
2nd–	6712	3212			

(3) Notes

The gear/clutch signals (CTH1A, CTH2A) are also used to select parameters for Series 15 rigid tapping, feed axis position gain in Cs contouring control, the number of teeth of an arbitrary gear, time constant, backlash, and so forth.

2.8 SPINDLE SWITCHING CONTROL

2.8.1 Start–up Procedure

A. Check the connections.

↓

B. Prepare and check the ladder programs. (Refer to the descriptions (B–65162E).)

↓

C. Perform automatic spindle parameter initialization (for both the main spindle and sub spindle sides).
(See Section 2.8.4(1).)
- Motor model code
- Automatic spindle parameter initialization function

↓

D. When no model code is available, change the parameter data according to the parameter list for each model (for both the main spindle and sub spindle sides).

↓

E. Set the parameters related to spindle switching control. (See Section 2.8.3.)

↓

F. When a nonstandard combination of motor and amplifier is used, change the parameters below (for both the main spindle and sub spindle sides). (See Section 2.8.4(2).)
- Current dead zone data
- Current conversion constant
- Current prediction constant

↓

G. Check spindle switching operation.

↓

H. Check the waveforms of the detector feedback signals (on both the main spindle and sub spindle sides).

↓

I. Check the operation of both the main spindle and sub spindle sides.

2.8.2 DI/DO Signals Related to Spindle Switching Control

(1) Input signals (PMC → CNC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	G229 G233	G227 G235	G227 G235	G070 G074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
1st– 2nd–	G230 G234	G226 G234	G226 G234	G071 G075	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
1st– 2nd–	G231 G235	G229 G237	G229 G237	G072 G076	RCHHGA	MFNHGA	INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA

(2) Output signals (CNC → PMC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st– 2nd–	F281 F285	F229 F245	F229 F245	F045 F049	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
1st– 2nd–	F282 F286	F228 F244	F228 F244	F046 F050					RCFNA	RCHPA	CFINA	CHPA

2.8.3 Parameters Related to Spindle Switching Control

Parameter No.						Description	Main spindle side/ sub spindle side
0		15		15*i*	16*i*/16		
1st spindle	2nd spindle	1st spindle	2nd spindle				
6519 #7	6659 #7	5607 #0	5607 #1	5607 #0	4019 #7	Automatic parameter initialization function	Main spindle side
6633	6773	3133	3273	3133	4133	Model code	
6159 #7	6339 #7	5607 #0	5607 #1	5607 #0	4195 #7	Automatic parameter initialization function	Sub spindle side
6273	6453	3453	3673	3309	4309	Model code	
6514 #0	6654 #0	3014 #0	3154 #0	3014 #0	4014 #0	Whether to use the spindle switching control function (Set this bit to 1.)	
6514 #2	6654 #2	3014 #2	3154 #2	3014 #2	4014 #2	Function for checking the contacts of the electromagnetic contactors for the main spindle and sub spindle sides, subject to spindle switching	
6514 #1	6654 #1	3014 #1	3154 #2	3014 #1	4014 #1	Spindle switching function during sub spindle rotation	

Parameter No.						Description	Main spindle side/ sub spindle side
0		15		15*i*	16*i*/16		
1st spindle	2nd spindle	1st spindle	2nd spindle				
6513 #6 to 2	6653 #6 to 2	3013 #6 to 2	3153 #6 to 2	3013 #6 to 2	4013 #6 to 2	Current dead zone data	Main spindle side
6610	6750	3110	3250	3110	4110	Current conversion constant	
6612	6752	3112	3252	3112	4112	Current prediction constant	
6524	6664	3024	3164	3024	4024	Speed zero detection level	
6153 #6 to 2	6333 #6 to 2	3333 #6 to 2	3553 #6 to 2	3189 #6 to 2	4189 #6 to 2	Current dead zone data	Sub spindle side
6228	6408	3408	3628	3264	4264	Current conversion constant	
6230	6410	3410	3630	3266	4266	Current prediction constant	
6163	6343	3343	3563	3199	4199	Speed zero detection level	

2.8.4 Parameter Setting Procedure

(1) Automatic spindle parameter initialization

¿¿ Set the model code for the motor to be used for automatic parameter initialization.

When a motor has no corresponding model code, set the code for a similar model, or set model code 0.

CNC	Parameter No.				Settings
	1st spindle		2nd spindle		
	Main spindle side	Sub spindle side	Main spindle side	Sub spindle side	
0	6633	6273	6773	6453	Model code
15	3133	3453	3273	3673	
15*i*	3133	3309	3133	3309	
16*i*/16	4133	4309	4133	4309	

③ Set the parameter for automatic spindle parameter initialization.

CNC	Parameter No.				Settings
	1st spindle		2nd spindle		
	Main spindle side	Sub spindle side	Main spindle side	Sub spindle side	
0	6519 #7	6159 #7	6659 #7	6339 #7	1
15	5607 #0		5607 #1		0
15*i*	5607 #0		5607 #0		0
16*i*/16	4019 #7	4195 #7	4019 #7	4195 #7	1

NOTE
This bit is reset to its original value after automatic parameter initialization.

④ Briefly turn the CNC off, then back on again. Then, the spindle parameters specified with a model code are automatically initialized.

⑤ When there is no model code for the motor being used, manually change the parameter data by according to the parameter list for the motor models.

(2) Modifying parameter data for spindle switching control

Combining two different motors may require that the parameter data be modified.

In such a case, modify the parameter data after automatic parameter initialization.

① Check and modify the current dead zone data.

Set data according to the amplifier model being used.

Note that if invalid data is set, the switching device of the power circuitry may be damaged.

CNC	Parameter No.				Settings
	1st spindle		2nd spindle		
	Main spindle side	Sub spindle side	Main spindle side	Sub spindle side	
0	6513 #6 to 2	6153 #6 to 2	6653 #6 to 2	6333 #6 to 2	SPM–22 to SPM–15 0, 0, 1, 1, 0 SPM–22 to SPM–30 0, 1, 0, 0, 1 SPM–45 0, 1, 1, 1, 1
15	3013 #6 to 2	3333 #6 to 2	3153 #6 to 2	3553 #6 to 2	
15*i*	3013 #6 to 2	3189 #6 to 2	3013 #6 to 2	3189 #6 to 2	
16*i*/16	4013 #6 to 2	4189 #6 to 2	4013 #6 to 2	4189 #6 to 2	

⑵ Check and modify the current conversion constant data.

When a nonstandard combination of motor and amplifier is used, the data must be modified to suit the amplifier model being used.

CNC	Parameter No.				Settings
	1st spindle		2nd spindle		
	Main spindle side	Sub spindle side	Main spindle side	Sub spindle side	
0	6610	6228	6750	6408	Value obtained from the conversion formula indicated below.
15	3110	3408	3250	3628	
15*i*	3110	3264	3110	3264	
16*i*/16	4110	4264	4110	4264	

Conversion formula $\mathrm{ICONV2} = \mathrm{ICONV1} \times \frac{G1}{G2}$

ICONV1 : Current conversion constant before modification (value for standard amplifier)

ICONV2 : Current conversion constant after modification (value for amplifier being used)

G1 : Current detection gain of the standard amplifier model that matches the motor being used

G2 : Current detection gain of the amplifier model used with spindle switching

[Current detection gain list]

Amplifier model	Current detection gain G1, G2
SPM–2.2, SPM–5.5	60
SPM–11	30
SPM–15	20
SPM–22	15
SPM–26	10
SPM–30	7.5
SPM–45	6.67

¿¿ Check and modify the current prediction constant.

When a nonstandard combination of motor model and amplifier model is used, the data must be modified according to the amplifier being used.

CNC	Parameter No.				Settings
	1st spindle		2nd spindle		
	Main spindle side	Sub spindle side	Main spindle side	Sub spindle side	
0	6612	6230	6752	6410	Value obtained from the conversion formula indicated below.
15	3112	3410	3252	3630	
15*i*	3112	3266	3112	3266	
16*i*/16	4112	4266	4112	4266	

Conversion formula $\quad IEST2 = IEST1 \times \frac{G1}{G2}$

IEST1 : Current prediction constant before modification (value for the standard amplifier)

IEST2 : Current prediction constant after modification (value for the amplifier being used)

G1 : Current detection gain of the standard amplifier model that matches the motor being used

G2 : Current detection gain of the amplifier being used with spindle switching

2.8.5 Details of Parameters Related to Spindle Switching Control

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6514	3014	3014	4014						AXSLCT	AXSUB	AXISSL
2nd–	6654	3154										

AXISSL: Spindle switching function presence

Set to 1: spindle switching function present

AXSUB: Presence of spindle switching function when SUB spindle is rotating

0: No spindle switching function when SUB spindle is rotating

1: Spindle switching function available when SUB spindle is rotating

AXSLCT:

Specifies whether to check the contacts of the main magnetic contactor and sub-magnetic contactor for spindle switching

0: Makes a check by using the power line status check signal (MCFN).

1: Checks the contacts (MCFN, MFNHG) of the main magnetic contactor and sub-magnetic contactor.

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6513	3013	3013	4013		DS5	DS4	DS3	DS2	DS1		
2nd–	6653	3153										

(MAIN side)

1st–	6153	3333	3189	4189		DS5	DS4	DS3	DS2	DS1		
2nd–	6333	3553										

(SUB side)

DS5 to DS1:

Current dead zone data

This parameter data is determined by the amplifier being used.
When spindle switching control is used, a nonstandard amplifier, which does not match the motor, may be used.
In such a case, modify the data according to the amplifier being used. Note that if invalid data is set, the switching element of the power circuitry may be damaged.

DS5	DS4	DS3	DS2	DS1	Amplifier model
0	0	1	1	0	SPM–2.2 to SPM–15
0	1	0	0	1	SPM–22 to SPM–30
0	1	1	1	1	SPM–45

	0	15	15*i*	16*i*/16	
1st–	6524	3024	3024	4024	Speed zero detecting level (MAIN side)
2nd–	6664	3164			
1st–	6763	3343	3199	4199	Speed zero detecting level (SUB side)
2nd–	6343	3563			

Data unit : 0.01%
Data range : 0 to 10000
Standard setting : 75

This data is used to set the detecting range of speed zero detection signal (SSTA).

When the motor speed reaches (setting data/100)% or less of maximum speed, the bit of speed zero detection signal (SSTA) is set to ”1”.

	0	15	15*i*	16*i*/16	
1st–	6610	3110	3110	4110	Current conversion constant (MAIN side)
2nd–	6750	3250			
1st–	6228	3408	3264	4264	Current conversion constant (SUB side)
2nd–	6750	3628			

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

When spindle switching control is used, a nonstandard amplifier, which does not match the motor, may be used.
In such a case, modify the setting of this parameter according to the conversion formula below.

$$\mathrm{ICONV2} = \mathrm{ICONV1} \times \frac{G1}{G2}$$

where,

ICONV1 : Current conversion constant before modification (value specified when using the standard amplifier)

ICONV2 : Current conversion constant after modification (value for amplifier being used)

G1 : Current detection gain of the standard amplifier that matches the motor being used

G2 : Current detection gain of the amplifier being used for spindle switching

[Current detection gain list]

Amplifier model	Current detection gain G1, G2
SPM–2.2, SPM–5.5	60
SPM–11	30
SPM–15	20
SPM–22	15
SPM–26	10
SPM–30	7.5
SPM–45	6.67

0	15	15*i*	16*i*/16	
6612 6752	3112 3252	3112	4112	Current prediction constant (MAIN side)
6230 6410	3410 3630	3266	4266	Current prediction constant (SUB side)

Data unit :

Data range : 0 to 32767

Standard setting : Depends on the motor model.

When spindle switching control is used, a nonstandard amplifier model, which does not match the motor, may be used.
In such a case, modify the setting of this parameter according to the conversion formula below.

$$\mathrm{IEST2} = \mathrm{IEST1} \times \frac{G1}{G2}$$

where,

IEST1 : Current prediction constant before modification (value specified when using the standard amplifier)

IEST2 : Current prediction constant after modification (value for amplifier being used)

G1 : Current detection gain of standard amplifier that matches the motor being used

G2 : Current detection gain of the amplifier being used for spindle switching

2.8.6 Supplement to the Parameters

(1) The parameters listed below are common to both the main spindle and sub spindle sides. This means that separate values cannot be set in these parameters for the main spindle side and sub spindle side.

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st	2nd	1st	2nd			
6527	6667	3027	3167	3027	4027	Load detection level 2
6530	6670	3030	3170	3030	4030	Soft start/stop time
6587	6727	3087	3227	3081	4087	Excess speed level
6588	6728	3088	3228	3088	4088	Level for detecting excess velocity error when the motor is restrained
6589	6729	3089	3229	3089	4089	Level for detecting excess velocity error when the motor rotates
6590	6730	3090	3230	3090	4090	Overload detection level
6595	6735	3095	3235	3095	4095	Adjusted output voltage of speed meter
6596	6736	3096	3236	3096	4096	Adjusted output voltage of load meter
6598	6738	3098	3238	3098	4098	Maximum speed for position coder signal detection
6599	6739	3099	3239	3099	4099	Motor excitation delay
6623	6763	3123	3263	3123	4123	Overload detection time
6924	6964	3304	3524	3160	4160	Speed detection level hysteresis
6305	6485	3485	3705	3341	4341	Unexpected load detection level
6308	6488	3488	3708	3344	4344	Advanced feed–forward coefficient
6309	6489	3489	3709	3345	4345	Spindle motor speed command detection level
6310	6490	3490	3710	3346	4346	Incomplete integration coefficient

(2) Up to two stages can be specified for gear switching on the sub spindle side. The CTH1A input signal is used for selection.

(Up to four stages can be set on the main spindle side. The CTH1A and CTH2A input signals are used for selection.)

Parameter No.						Description	
0		15		15*i*	16*i*/16		
1st	2nd	1st	2nd				CTH1A
6180	6360	3360	3580	3216	4216	Gear ratio (SUB side, HIGH gear)	0
6181	6361	3361	3581	3217	4217	Gear ratio (SUB side, LOW gear)	1
6182	6362	3362	3582	3218	4218	Position gain in orientation (SUB side, HIGH gear)	0
6183	6363	3363	3583	3219	4219	Position gain in orientation (SUB side, LOW gear)	1
6185	6365	3365	3585	3221	4221	Position gain in servo mode (SUB side, HIGH gear)	0
6186	6366	3366	3586	3222	4222	Position gain in servo mode (SUB side, LOW gear)	1

(3) Velocity loop integral gain data for the sub spindle side can be specified for only one stage. The selection function using the CTH1A DI signal is not available.

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st	2nd	1st	2nd			
6176	6356	3356	3576	3212	4212	Velocity loop integral gain in normal operation (SUB side)
6177	6357	3357	3577	3213	4213	Velocity loop integral gain in orientation (SUB side)
6178	6358	3358	3578	3214	4214	Velocity loop integral gain in servo mode (SUB side)

2.9 SPINDLE DIFFERENTIAL SPEED CONTROL

2.9.1 Start–up Procedure

A. Check that normal operation can be performed.

B. Check the connections for spindle differential speed control.

C. Prepare and check the ladder programs for spindle differential speed control.

D. Set the parameters related to spindle differential speed control.

E. Check the spindle differential speed control operation.

NG

2.9.2 Signals Related to Spindle Control

(1) Input signals (PMC → CNC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	G231	G229	G229	G072	RCHHGA	MFNHGA	INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA
2nd–	G235	G237	G237	G076								

2.9.3 Parameters Related to Spindle Differential Speed Control

Parameter No.				Description
0	15	15*i*	16*i*/16	
6500 #5	3000 #5	3000 #5	4000 #5	Whether to use the differential speed mode function. (Set this bit to 1.)
6500 #6	3000 #6	3000 #6	4000 #6	Differential speed direction setting
6500 #0	3000 #0	3000 #0	4000 #0	Direction of spindle and motor rotation
6500 #2	3000 #2	3000 #2	4000 #2	Position coder mounting direction
6500 #7	3000 #7	3000 #7	4000 #7	Setting of the number of feedback signal pulses from the position coder for the spindle 1.
6501 #2	3001 #2	3001 #2	4001 #2	Whether to use a position coder signal
6502 #5	3002 #5	3002 #5	4002 #5	Setting of the rotation direction signal function in servo mode
6503 #7, 6, 5, 4	3003 #7, 6, 5, 4	3003 #7, 6, 5, 4	4003 #7, 6, 5, 4	Position coder signal setting

2.9.4 Details of the Parameters Related to Spindle Differential Speed Control

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st–	6500	3000	3000	4000	DEFRTO	DEFDRT	DEFMOD			POSC1		ROTA1
2nd–	6640	3140										

ROTA1: Indicates the relationship between the rotation directions of spindle and spindle motor.

0: Rotates the spindle and spindle motor in the same direction.

1: Rotates the spindle and spindle motor in the reverse direction.

Judge the spindle rotation direction in the same state as that when the motor rotation direction was judged from the motor shaft direction.

POSC1: Indicates the mounting direction of position coder.

0: Rotates the spindle and position coder in the same direction.

1: Rotates the spindle and position coder in the reverse direction.

Judge by position coder rotation direction when position coder rotation direction is viewed from position coder shaft. Judge by spindle rotation direction in the same state as that when the motor rotation direction was judged from the motor shaft direction.

DEFMOD:

Differential mode function presence

0: Differential mode function absent

1: Differential mode function present

DEFDRT:

Differential direction setting

0: Same as feedback signal

1: Opposite to feedback signal

DEFRTO:

Indicates the number of position coder pulses of the other spindle (spindle 1) in differential mode

0: 1024 p/rev × 4 (4096 p/rev)

1: 512 p/rev × 4 (2048 p/rev)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6501 6641	3001 3141	3001	4001						POSC2		

POSC2: Determines whether the position coder signal is used or not.

0: Not used.

1: Used.

Set this bit to ”1” when rigid tap function is present.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6502 6642	3002 3142	3002	4002			SVMDRT					

SVMDRT:

Setting of the rotation direction signal (SFR/SRV) function in servo mode (rigid tapping/Cs axis control)

0: Rotation direction function enabled
With a + motion command, the spindle rotates counterclockwise when SFR = 1, and the spindle rotates clockwise when SRV = 1.

1: Rotation direction function disabled
The rotation direction function of the SFR/SRV signal is disabled. With a + motion command, the spindle rotates counterclockwise when SFR = 1 or SRV = 1.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6503 6643	3003 3143	3003	4003	PCPL2	PCPL1	PCPL0	PCTYPE				

PCPL2, PCPL1, PCPL0, PCTYPE:

Selection of position coder.

Set depend on detector.

3 EXPLANATION OF PARAMETERS

This chapter describes all spindle parameters.

(1) The parameter numbers given in the description below are those for the Series 16**i**/16. Note that when using another series, the parameter numbers may differ.

(2) The table below lists the abbreviations used to indicate the different series used in the description of parameters. Note that the availability of functions varies with the series. For details, refer to the relevant manual.

<table>
<tr><th>Series</th><th colspan="2">Abbreviation used in text</th><th colspan="2">Abbreviation used in tables</th></tr>
<tr><td>FANUC Series 0–T</td><td>Series 0–T</td><td rowspan="2">Series 0</td><td>0T</td><td rowspan="2">0</td></tr>
<tr><td>FANUC Series 0–M</td><td>Series 0–M</td><td>0M</td></tr>
<tr><td>FANUC Series 15</td><td colspan="2">Series 15</td><td colspan="2">15</td></tr>
<tr><td>FANUC Series 15i</td><td colspan="2">Series 15i</td><td colspan="2">15i</td></tr>
<tr><td>FANUC Series 16</td><td colspan="2">Series 16</td><td colspan="2" rowspan="12">16i/16</td></tr>
<tr><td>FANUC Series 16i</td><td colspan="2">Series 16i</td></tr>
<tr><td>FANUC Series 18</td><td colspan="2">Series 18</td></tr>
<tr><td>FANUC Series 18i</td><td colspan="2">Series 18i</td></tr>
<tr><td>FANUC Series 21</td><td colspan="2">Series 21</td></tr>
<tr><td>FANUC Series 21i</td><td colspan="2">Series 21i</td></tr>
<tr><td>FANUC Series 20</td><td colspan="2">Series 20</td></tr>
<tr><td>FANUC Series 20i</td><td colspan="2">Series 20i</td></tr>
<tr><td>FANUC Power Mate–MODEL D</td><td colspan="2" rowspan="2">Power Mate–D/F</td></tr>
<tr><td>FANUC Power Mate–MODEL F</td></tr>
<tr><td>FANUC Power Mate i–MODEL D</td><td colspan="2">Power Mate i–D</td></tr>
</table>

(3) The parameter numbers indicated in the upper row are used for the 1st spindle, while those indicated in the lower row are used for the 2nd spindle.

(4) In general, the parameters are classified according to the table below. Note, however, that some parameters are not classified as indicated.

Whether spindle switching control is used	**Whether speed range switching control is used**	**0**		**15**		**15*i***	**16*i*/16**
		1st	**2nd**	**1st**	**2nd**		
When spindle switching control is not used and For the main spindle side when spindle switching control is used	When speed range switching control is not used and For high–speed range when speed range switching control is used	6500 to 6635	6640 to 6775	3000 to 3135	3140 to 3275	3000 to 3135	4000 to 4135
	For low–speed range when speed range switching control is used	6900 to 6939	6940 to 6979	3280 to 3319	3500 to 3539	3136 to 3175	4136 to 4175
For the sub spindle side when spindle switching control is used	When speed range switching control is not used and For high–speed range when speed range switching control is used	6140 to 6247	6320 to 6427	3320 to 3427	3540 to 3647	3176 to 3283	4176 to 4283
	For low–speed range when speed range switching control is used	6248 to 6315	6428 to 6495	3428 to 3495	3648 to 3715	3284 to 3351	4284 to 4351

3.1 SPINDLE PARAMETERS (COMMON TO ALL MODELS)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6500 6640	3000 3140	3000	4000	DEFRTO	DEFDRT	DEFMOD	RETSV	RETRN	POSC1	ROTA2	ROTA1

Standard setting: 0 0 0 0 0 0 0 0

ROTA1: Indicates the relationship between the rotation directions of spindle and spindle motor.

0: Rotates the spindle and spindle motor in the same direction.

1: Rotates the spindle and spindle motor in the reverse direction.

Method of judging spindle and rotation direction
Judge the spindle rotation direction in the same state as that when the motor rotation direction was judged from the motor shaft direction.
For example, when the spindle and motor are connected by a belt, the setting becomes ”same rotation direction”.

ROTA2: Indicates the spindle direction by the motion command (+). (Only effective in Cs contouring control) The power mate does not have this function.

0: Rotates the spindle in CCW (counter clockwise) direction.

1: Rotates the spindle in CW (clockwise) direction.

POSC1: Indicates the mounting direction of position coder.

0: Rotates the spindle and position coder in the same direction.

1: Rotates the spindle and position coder in the reverse direction.

Judge by rotation direction when position coder rotation direction is viewed from position coder shaft.

RETRN: Indicates the reference point return direction in Cs contouring control. The power mate does not have this function.

0: Returns the spindle from the CCW direction to the reference point (counter clockwise direction).

1: Returns the spindle from the CW direction to the reference point (clockwise direction).

RETSV: Indicates reference point return direction (rigid tap/spindle positioning etc.) when in servo mode.

0: Spindle reference point returns CCW (counter clockwise)

1: Spindle reference point returns CW (clockwise)

DEFMOD:

Differential mode function presence

0: Differential mode function absent

1: Differential mode function present

DEFDRT:

Differential direction setting

0: Same as feedback signal

1: Opposite to feedback signal

DEFRTO:

Indicates the number of position coder signal pulses of the other spindle (spindle 1) in differential mode.

0: 1024 p/rev × 4 (4096 p/rev)

1: 512 p/rev × 4 (2048 p/rev)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6501 6641	3001 3141	3001	4001	CAXIS3	CAXIS2	CAXIS1		MGSEN	POSC2		MRDY1
Standard setting:				0	0	0	0	0	0	0	1

MRDY1: Determines whether the MRDYA signal (machine ready signal) is used or not.

0: Not used. (The MRDYA signal should be always set to 1.)

1: Used.

POSC2: Determines whether the position coder signal is used or not.

0: Not used.

1: Used.

Set this bit to ”1” when using the following functions: servo mode (rigid tap/spindle positioning etc.), spindle synchronization control and position coder method spindle orientation.
Beware that if this bit is set to ”1” with no position coder signal input, then the position coder disconnection alarm (AL-27) will occur.

MGSEN: Indicates the mounting direction of magnetic sensor.

0: Rotates the motor and magnetic sensor in the same direction.

1: Rotates the motor and magnetic sensor in the reverse direction.

CAXIS1: Determines whether the high-resolution magnetic pulse coder is used or not.
The Power Mate does not have this function.

0: Not used.

1: Used.

CAXIS2: Also used in speed detection of the Cs contour control position detection signal.The Power Mate does not have this function.

0: Not used. (when spindle and spindle motor are separated)

1: Used. (in case of built-in spindle motor)

CAXIS3: Indicates the mounting direction for the Cs contour control.
The Power Mate does not have this function.

0: Rotates the spindle and position detection in the same direction.

1: Rotates the spindle and position detection in the reverse direction.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6502 6642	3002 3142	3002	4002	PCEN	SYCDRT	SVMDRT	CSDRCT		CSDET3	CSDET2	CSDET1
Standard setting:				0	0	0	0	0	0	0	0

CSDET3-1:

Cs contouring control resolution setting. The Power Mate does not have this function.

(To be set to 000 usually)

These bits of this parameter are invalid in the α spindle sensor Cs contour control.

CSDET3	CSDET2	CSDET1	
0	0	0	360000 p/rev.
0	0	1	180000 p/rev.
0	1	0	120000 p/rev.
0	1	1	90000 p/rev.
1	0	0	60000 p/rev.
1	0	1	40000 p/rev.
1	1	0	20000 p/rev.
1	1	1	10000 p/rev.

CSDRCT:

Setting of the rotation direction signal (SFR/SRV) function when Cs contouring control is used. The Power Mate does not have this function.

0: Rotation direction function enabled

When bit 1 (ROTA2) of parameter No. 4000 is 0

With motion command in the plus direction, the spindle rotates counterclockwise when SFR = 1, and the spindle rotates clockwise when SRV = 1.

When bit 1 (ROTA2) of parameter No. 4000 is 1

With motion command in the plus direction, the spindle rotates clockwise when SFR = 1, and the spindle rotates counterclockwise when SRV = 1.

1: Rotation direction function disabled

The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor excitation is available.

When bit 1 (ROTA2) of parameter No. 4000 is 0

With motion command in the plus direction, the spindle rotates counterclockwise when SFR = 1 or SRV = 1.

When bit 1 (ROTA2) of parameter No. 4000 is 1

With motion command in the plus direction, the spindle rotates clockwise when SFR = 1 or SRV = 1.

SVMDRT:

Setting of the rotation direction signal (SFR/SRV) function in servo mode (rigid tapping/spindle positioning)

0: Rotation direction function enabled

With motion command in the plus direction, the spindle rotates counterclockwise when SFR = 1, and the spindle rotates clockwise when SRV = 1.

1: Rotation direction function disabled

The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor excitation is available. With motion command in the plus direction, the spindle rotates counterclockwise when SFR = 1 or SRV = 1.

SYCDRT:

Setting of the rotation direction signal (SFR/SRV) function when spindle synchronization control is used

0: Rotation direction function enabled

With spindle synchronization speed command, in the plus direction the spindle rotates counterclockwise when SFR = 1, and the spindle rotates clockwise when SRV = 1.

1: Rotation direction function disabled

The rotation direction function of the SFR/SRV signal is disabled. Only the function for enabling spindle motor excitation is available. With spindle synchronization speed command, in the plus direction the spindle rotates counterclockwise when SFR = 1 or SRV = 1.

PCEN: Setting of the function of enabling CMR for a move command in servo mode

0: Disables CMR.

1: Enables CMR.

$$\mathrm{CMR} = \frac{4096}{\text{Number of pulses based on Cs detector resolution}}$$

(according to bits 0, 1, and (CSDET3, 2, and 1) of parameter No. 4002)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6503 6643	6503 3143	3003	4003	PCPL2	PCPL1	PCPL0	PCTYPE	DIRCT2	DIRCT1	PCCNCT	PCMGSL
Standard setting:				0	0	0	0	0	0	0	0

PCMGSL:

Selection of position coder method/magnetic sensor method spindle orientation

This function requires the spindle orientation function, (a CNC software option).

In addition, setting parameter (ORIENT) to ”1” is required.

0: Position coder method spindle orientation function

1: Magnetic sensor method spindle orientation function

PCCNCT:

Specifies whether a MZ sensor or BZ sensor (built–in motor) is used.

0: Not used.

1: Used.

Set this bit to 1 when a MZ sensor (built–in sensor) in a motor is used. Also, set this bit to 1 also when a built–in motor's MZ sensor (built–in sensor) is used.

DIRCT2-DIRCT1:

Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before
0	1	By rotation direction immediately before
1	0	CCW (counterclockwise) direction looking from shaft of motor
1	1	CW (clockwise) direction looking from shaft of motor

PCPL2, PCPL1, PCPL0, PCTYPE:

Set a position coder signal.

PCPL2	PCPL1	PCPL0	PCTYPE	MZ sensor, BZ sensor (built–in sensor)	High-resolution magnetic pulse coder	Others
0	0	0	0	256 λ/rev (φ103)	Magnetic drum diameter φ65	Position coder, High–resolution position coder
0	0	0	1	128 λ/rev (φ52)	–	–
0	1	0	0	512 λ/rev (φ205)	φ130	–
0	1	0	1	64 λ/rev (φ26)	–	–
1	0	0	0	–	φ195	–
1	1	0	0	384 λ/rev (φ154)	φ97.5	–

Set these bits to "0000" when using a position coder or high–resolution position coder. When a high–resolution magnetic pulse coder is used, these bits set the signal used for Cs contouring control. If these bits are not set correctly, a one–rotation signal detection error alarm (AL–39) is issued.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6504 6644	3004 3144	3004	4004				BISGAN	RFTYPE	EXTRF	SPDBIS	HRPC

Standard setting: 0 0 0 0 0 0 0 0

HRPC: Specifies whether a high–resolution position coder is used.

0: Not used.

1: Used.

SPDBIS: Specifies whether a BZ sensor (built–in sensor) on the spindle is used.

0: Not used.

1: Used.

Set this bit to 1 when a position coder signal is obtained by mounting a BZ sensor (built–in sensor) onto the spindle.
Set this bit to 0 when a built–in motor's BZ sensor (built–in sensor) is used.

EXTRF: Specifies whether a reference switch signal is used.

0: Not used.

1: Used.

RFTYPE: Specifies whether to invert the external one–turn signal.

0: The final signal is to be inverted.

1: The final signal is not to be inverted.

BISGAN:

Specifies the built–in sensor in motor models α0.5, 0.3S, 0.5S, and IP65 (1S to 3S) (9D00.D).

0: Other than the case below (for α0.5 (B380))

1: Motor model α0.5 (B390) with a MZ sensor

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6506 6646	3006 3146	3006	4006	BLTRGD		ALGOVR		SYCREF	SPDUNT	GRUINT	

Standard setting:	0	0	0	0	0	0	0	0

GRUNIT:

Gear ratio setting resolution setting

0: 1/100 units (Under normal circumstances, set to "0".)

1: 1/1000 units

This parameter is used for gear ratio data setting to select whether to set the number of motor revolutions for 1 revolution of the spindle as a multiple of 100 or as a multiple of 1,000.
When the gear ratio is a fraction at 1/100, there may be a constant synchronization error indicated in spindle synchronization control.
In this sort of situation, using setting units of 1/1000 makes the synchronization error appear much smaller.
These parameters change the following parameter settings.

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st	2nd	1st	2nd			
6556	6696	3056	3196	3056	4056	Gear ratio (HIGH)
6557	6697	3057	3197	3057	4057	Gear ratio (MEDIUM HIGH)
6558	6698	3058	3198	3058	4058	Gear ratio (MEDIUM LOW)
6559	6699	3059	3199	3059	4059	Gear ratio (LOW)

SPDUNT:

Setting the unit of speed

0: 1 min^{-1} setting (”0” is usually chosen)

1: 10 min^{-1} setting

Choose ”1” for motors with a maximum speed of more than 32767 min^{-1}.

These parameters change the following parameter settings.

- Under normal control

Parameter No.						Description	Parameter setting unit	
0		15		15*i*	16*i*/16		1min^{-1}	10min^{-1}
1st	2nd	1st	2nd					
6520	6660	3020	3160	3020	4020	Maximum speed	1min^{-1}	10min^{-1}
6521	6661	3021	3161	3021	4021	Maximum speed in Cs contouring control	1min^{-1}	10min^{-1}
6530	6670	3030	3170	3030	4030	Soft start/stop setting time	1min^{-1} /sec	10min^{-1} /sec
6532	6672	3032	3172	3032	4032	Acceleration/deceleration time constant at spindle synchronization control	1min^{-1} /sec	10min^{-1} /sec
6533	6673	3033	3173	3033	4033	Spindle synchronization rotation speed arrival level	1min^{-1}	10min^{-1}
6574	6714	3074	3214	3074	4074	Origin return speed when Cs contouring or servo mode	1min^{-1}	10min^{-1}
6598	6738	3098	3238	3098	4098	Maximum speed for position coder signal detection	1min^{-1}	10min^{-1}
6600	6740	3100	3240	3100	4100	Base speed of motor power specifications	1min^{-1}	10min^{-1}
6602	6742	3102	3242	3102	4102	Base speed	1min^{-1}	10min^{-1}
6603	6743	3103	3248	3108	4103	Magnetic fiux down start speed	1min^{-1}	10min^{-1}
6608	6748	3108	3248	3108	4108	Current loop integral gain zero point	1min^{-1}	10min^{-1}
6626	6766	3126	3266	3126	4126	Velocity command on automatic operation	1min^{-1}	10min^{-1}
6628	6768	3128	3268	3128	4128	Maximum power limit zero point	1min^{-1}	10min^{-1}
Low speed range parameters for speed range switching control (when speed range switching function exists)								
6902	6942	3282	3502	3138	4138	Base speed of motor power specifications	1min^{-1}	10min^{-1}
6904	6944	3284	3504	3140	4140	Base speed	1min^{-1}	10min^{-1}
6905	6945	3285	3505	3141	4141	Magnetic flux down start speed	1min^{-1}	10min^{-1}
6908	6948	3288	3508	3144	4144	Current loop integral gain zero point	1min^{-1}	10min^{-1}
6922	6962	3302	3522	3158	4158	Maximum power limit zero point	1min^{-1}	10min^{-1}
6924	6964	3304	3524	3160	4160	Speed detection level hysteresis	1min^{-1}	10min^{-1}

D Under spindle HRV control

Parameter No.						Description	Parameter setting unit	
0		15		15*i*	16*i*/16		1min^{-1}	10min^{-1}
1st	2nd	1st	2nd					
6520	6660	3020	3160	3020	4020	Maximum speed	1min^{-1}	10min^{-1}
6521	6661	3021	3161	3021	4021	Maximum speed in Cs contouring control	1min^{-1}	10min^{-1}
6530	6670	3030	3170	3030	4030	Soft start/stop setting time	1min^{-1} /sec	10min^{-1} /sec
6532	6672	3032	3172	3032	4032	Acceleration/deceleration time constant at spindle synchronization control	1min^{-1} /sec	10min^{-1} /sec
6533	6673	3033	3173	3033	4033	Spindle synchronization rotation speed arrival level	1min^{-1}	10min^{-1}
6574	6714	3074	3214	3074	4074	Origin return speed when Cs contouring or servo mode	1min^{-1}	10min^{-1}
6598	6738	3098	3238	3098	4098	Maximum speed for position coder signal detection	1min^{-1}	10min^{-1}
6600	6740	3100	3240	3100	4100	Base speed of motor power specifications	1min^{-1}	10min^{-1}
6602	6742	3102	3242	3102	4102	Activating voltage saturation speed at no–load	1min^{-1}	10min^{-1}
6608	6748	3108	3248	3108	4108	Current loop integral gain zero point	1min^{-1}	10min^{-1}
6626	6766	3126	3266	3126	4126	Velocity command on automatic operation	1min^{-1}	10min^{-1}
Low speed range parameters for speed range switching control (when speed range switching function exists)								
6902	6942	3282	3502	3138	4138	Base speed of motor power specifications	1min^{-1}	10min^{-1}
6904	6944	3284	3504	3140	4140	Activating voltage saturation speed at no–load	1min^{-1}	10min^{-1}
6908	6948	3288	3508	3144	4144	Current loop integral gain zero point	1min^{-1}	10min^{-1}
6924	6964	3304	3524	3160	4160	Speed detection level hysteresis	1min^{-1}	10min^{-1}

SYCREF:

Setting for function performing automatic detection of the one–rotation signal in spindle synchronization control

0: Automatic detection of the one–rotation signal carried out

1: Automatic detection of the one–rotation signal not carried out. (When spindle phase synchronization is not carried out)

ALGOVR:

Setting of a spindle analog override range

0: 0% to 100%

1: 0% to 120%

BLTRGD:

Setting for rigid tapping using the arbitrary gear ratio (command) in the built–in MZ sensor built–in sensor

0: In cases other than below

1: When rigid tapping is performed using the MZ sensor in the motor

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0	
6507 6647	3007 3147	3007	4007	PHAICL	PCALCH	PCLS						Conventional
					PCALCH	PCLS						HRV

Standard setting: 0 0 0 0 0 0 0 0

PCLS : Determines high-resolution magnetic pulse coder and position coder signal disconnection detection.

0: Performs disconnection detection. (Normally set to ”0”)

1: Does not perform disconnection detection.

Set it to 0:

AL-26 (High-resolution magnetic pulse coder speed detecting signal disconnection),
AL-27 (Position coder signal disconnection) and
AL-28 (High-resolution magnetic pulse coder speed detecting signal disconnection) are checked.
Set it to ”1” temporarily when adjustment is difficult when adjusting location and speed feedback signal waves and the disconnection alarm occurs. After adjustment reset it to ”0”.

PCALCH:

Enables or disables detection of the alarms (AL-41, 42, 47) related to the position coder signal

0: Detects the alarms related to the position coder signal.

1: Does not detect the alarms related to the position coder signal.

When this bit is set to 0, AL–41 (position coder one–rotation signal detection error), AL–42 (position coder one–rotation signal not detected), and AL–47 (position coder signal error) are checked.
When the spindle is not connected to a position coder on a one–to–one basis, set this bit to 1 to prevent detection errors.

PHAICL:

Setting of a motor voltage pattern when no loads are imposed
Usually, set this parameter to 1.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0	
6509 6649	3009 3149	3009	4009		OVRTVP	TRSPCM	LDTOUT	PCGEAR	ALSP	RVSVCM	VLPGAN	Conventional
					OVRTVP		LDTOUT	PCGEAR	ALSP	RVSVCM	VLPGAN	HRV

Standard setting: 0 0 0 0 0 0 0 0

VLPGAN:

Setting unit of speed control loop gain

0: To be set usually (Normally set to ”0”)

1: Multiplies the normal setting by 1/16.

RVSVCM:

Specifies whether the speed command and speed feedback signal are reversed in slave operation:

0: Not reversed.

1: Reversed.

ALSP: Specifies how to turn off the power to the motor when AL–24 (serial transfer data error) is issued.

0: The power to the motor is turned off once the motor has been decelerated and stopped.

1: The power to the motor is turned off immediately.

Set this bit to 1 to turn off the power to the motor immediately upon the issue of a spindle alarm.

PCGEAR:

Specifies whether the arbitrary gear ratio (between the spindle and position coder) function (proximity switch) is used.

0: Not used.

1: Used.

Set this bit to 1 to use the function for spindle orientation with a reference switch.

Set an arbitrary gear ratio in parameter Nos. 4171 to 4174.

LDTOUT:

Specifies whether the load detection signals (LDT1, LDT2) are output during acceleration/deceleration.

0: Not output during acceleration/deceleration.

1: Output (at all times) during acceleration/deceleration if the level set in the parameter is exceeded.

TRSPCM:

Specifies the method of output compensation (9D00.D).

The method varies with the motor model.

OVRTYP:

Specifies an analog override type (9D00.D).

0: Override of linear function type

1: Override of quadratic function type

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0	
6511 6651	3011 3151	3011	4011	POLE2		ADJG	MXPW	POLE1	VDT3	VDT2	VDT1	Conventional
				POLE2			MXPW	POLE1	VDT3	VDT2	VDT1	HRV

Standard setting: X 0 X X X X X X

X: Depends on the motor model.

VDT3-VDT1:

Setting of speed detector

VDT3	VDT2	VDT1	Setting of speed detector	
0	0	0	64 λ/rev	
0	0	1	128 λ/rev	
0	1	0	256 λ/rev	
0	1	1	512 λ/rev	
1	0	0	192 λ/rev	(9D00.D)
1	0	1	384 λ/rev	(9D00.D)

POLE2, POLE1 No. of motor poles

POLE2	POLE1	No. of motor poles	
0	0	2 poles	
0	1	4 poles	
1	0	8 poles	
1	1	6 poles	(9D20)

MXPW: Settings of maximum power when accelerating and decelerating
Depends on the motor model

ADJG: Settings of acceleration and deceleration judging conditions on maximum power when accelerating and decelerating
Depends on the motor model

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6512 6652	3012 3152	3012	4012	SPHRV						PWM2	PWM1

Standard setting: 0 0 0 0 0 0 X X

X: Depends on the motor model.

PWM2-PWM1:

Setting of PWM carrier frequency
Normally set to ”00”.

SPHRV: Choice of motor control method

0: Chooses the conventional control method.

1: Chooses the spindle HRV control method.
Motor model–specific parameters need be set up according to the control scheme used.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6513 6653	3013 3153	3013 3153	4013	PWM3K	DS5	DS4	DS3	DS2	DS1	ESED	ESEC
Standard setting:				0	X	X	X	X	X	1	0

X: Depends on the amplifier model.

ESEC: Setting of detection edge of position coder one rotation signal

0: CCW=Rising edge CW=Falling edge (Normally set to ”0”)

1: CCW, CW=Rising edge

ESED : Setting of detection edge of one rotation signal of position detection signal in Cs contouring control

0: CCW=Rising edge CW=Falling edge

1: CCW, CW=Rising edge (Normally set to ”1”)

DS5-DS1:

Set the current dead band data.

PWM3K:

Setting PWM carrier frequency in low speed characteristic area of speed range switching control
Determined depending on the motor model.
Normally, set to ”0”.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6514 6654	3014 3154	3014 3154	4014		SYCORI	SLVEN	PCMGOR	CHGSLT	AXSLCT	AXSUB	AXISSL
Standard setting:				0	0	0	0	0	0	0	0

AXISSL: Spindle switching function presence

0: Spindle switching function absent

1: Spindle switching function present

AXSUB: Presence of spindle switching function when SUB spindle is rotating

0: No spindle switching function when SUB spindle is rotating

1: Spindle switching function available when SUB spindle is rotating

AXSLCT:

Specifies whether to check the contacts of the main magnetic contactor and sub-magnetic contactor for spindle switching

0: Makes a check by using the power line status check signal (MCFN).

1: Checks the contacts of the main magnetic contactor and sub-magnetic contactor.

CHGSLT: Specifies whether to check the contacts of the high and low magnetic contractors for speed range switching

0: Makes a check by using the power line status check signal (RCH).

1: Checks the contacts of the high and low magnetic contactors.

PCMGOR:

Selects spindle orientation by a position coder and/or by a magnetic sensor.

0: Selects only one type of spindle orientation (according to the setting of bit 0 (PCMGSL) of parameter No. 4003.).

1: Selects both types of spindle orientation.

SLVEN: Specifies whether the slave operation function is used.

0: Not used.

1: Used.

SYCORI:

Specifies whether the orientation function is used during spindle synchronization (9D00.D).

0: Not used.

1: Used.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6515 6655	3015 3155	3015	4015						SPDSW	SPLDMT	ORIENT

Standard setting:	0	0	0	0	0	0	0	0

ORIENT:

Presence of spindle orientation function (CNC software option)

0: Without spindle orientation function

1: With spindle orientation function

SPLDMT:

Specifies whether the spindle load monitor function is used (9D00.D). (To use this function, the CNC software option is required.)

0: Not used.

1: used.

SPDSW: Presence of speed range switching function (CNC software option)

0: Without speed range switching function

1: With speed range switching function

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6516 6656	3016 3156	3016 3156	4016	RFCHK3	RFCHK2	RFCHK1	CMTVL	FFSMTH			

Standard setting:	0	0	0	0	0	0	0	0

FFSMTH:

Presence of smoothing function on feedforward control

0: Without smoothing function

1: With smoothing function

Sets the presence of smoothing function on feedforward control of servo mode (rigid tap, Spindle positioning etc.) and Cs contouring control.

CMTVL: Control properties settings in Cs contouring control
The Power Mate does not have this function.
Set ”0” as normal, and check that the motor voltage in Cs contouring control (NO.4086) is ”100”.
When NO. 4086 is set to less than 100, set this bit to ”1”.

RFCHK1:
Presence of 1 rotation signal error detection function in Cs contouring control (AL-39).
The Power Mate does not have this function.

0: 1 rotation signal error detection (AL-39) function not present

1: 1 rotation signal error detection (AL-39) function present

RFCHK2:
Presence of 1 rotation signal error detection function for position coder signal (AL-46)

0: 1 rotation signal error detection (AL-46) function not present

1: 1 rotation signal error detection (AL-46) function present

RFCHK3:
Presence of function for redetecting the 1 rotation signal for the position coder signal each time spindle orientation/spindle synchronization control/rigid tap zero return mode is entered.

0: The 1 rotation signal is not detected each time the operating mode changes.

Once the 1 rotation signal has been detected, it is not detected again until the power goes off.

1: The 1 rotation signal is detected each time the operating mode changes.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6517 6657	3017 3157	3017	4017	NRROEN				PC1CAT	RFCHK4		
Standard setting:				0	0	0	0	0	0	0	0

RFCHK4:
Specifies whether to use the position coder 1- rotation signal detection function in normal rotation

0: Does not detect the 1-rotation signal in normal rotation.

1: Detects the 1-rotation signal in normal rotation.

PC1CAT:
Specifies whether a position coder one–rotation signal is detected during spindle orientation by a magnetic sensor.

0: Not detected.

1: Detected.

NRROEN:
Specifies whether the shortcut function is used when spindle orientation by a position coder is performed from the stop state.

0: Not used.

1: Used.

When this bit is set to 1, the shortcut function is used when the following requirements are satisfied:

- Bit 7 (RFCHK3) of parameter No. 4016 is set to 0.
- The speed zero signal SST is set to 1.
- The shortcut command NRRO is set to 1.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0	
6519 6659	3019 3159	3019	4011	PRLOAD		VDCV1	SDTCHG		SSTTRQ		DTTMCS	Conventional
				PRLOAD			SDTCHG		SSTTRQ			HRV
Standard setting:				0	0	0	0	0	0	0	0	

DTTMCS:
Specifies whether to apply dead zone compensation in Cs contouring control

0: Does not apply dead zone compensation.

1: Applies dead zone compensation.

SSTTRQ:
Specifies whether to use torque clamping at speed of 0

0: Uses clamping.

1: Does not use clamping.

SDTCHG:
Specifies whether to switch from high–speed range to low–speed range, upon the speed detection signal (SDT) being set to 1, when speed range switching is used.

0: Switches from the high-speed to low-speed range regardless of the speed detection signal (SDT).

1: Switches from the high-speed to low-speed range at the speed detection signal SDTA = 1 or lower.

VDCV1: Specifies whether DC link voltage detection filter processing is performed.

0: Performed. (Normally set to 0)

1: Not performed.

PRLOAD:
Parameter automatic setting function (Power Mate, Series 0, Series 16**i**/16)

0: Parameter automatic setting is not executed.

1: Parameter automatic setting is executed.

Set the motor model code in parameter No. 4113, and set this bit to 1. Then, briefly turn the CNC off, then on again. Then, the Series spindle parameters (Nos. 4000 to 4175), corresponding to the specified model, are automatically initialized.
Upon the completion of automatic parameter initialization, this bit is automatically reset to 0.

> **NOTE**
> With FS15/15*i*, the different parameter address, bit 0 of parameter No. 5607, is used for this function.
> Note also that the setting function is reversed.
> 0: Automatic parameter initialization is performed.
> 1: Automatic parameter initialization is not performed.
> Set a model code in parameter No. 3133.

0	15	15*i*	16*i*/16	
6520 6660	3020 3160	3020	4020	Maximum speed

Data unit : 1 min^{-1}
(when parameter No. 4006 #2 (SPDUNT) = 1, 10 min^{-1})
Data range : 0 to 32767
Standard setting : Depends on a motor model.
This data is used to set the maximum speed of AC spindle motor.

0	15	15*i*	16*i*/16	
6521 6661	3021 3161	3021	4021	Maximum speed in Cs contouring control

Data unit : 1 min^{-1}
(when parameter No. 4006 #2 (SPDUNT) = 1, 10 min^{-1})
Data range : 0 to 32767
Standard setting : 100
Set maximum spindle speed in Cs contouring control.

0	15	15*i*	16*i*/16	
6522 6662	3022 3162	3022	4022	Speed arrival detection level

Data unit : 0.1%
Data range : 0 to 1000 (0 to 100%)
Standard setting : 150 (15%)
This data is used to set the detecting range of speed arrival signal (SARA). When the motor speed reaches the range within ^ (setting data/10)% of commanded speed, the bit of speed arrival signal (SARA) is set to ”1”.

0	15	15*i*	16*i*/16	
6523 6663	3023 3163	3023	4023	Speed detecting level

Data unit : 0.1%
Data range : 0 to 1000 (0 to 100%)
Standard setting : 30 (3%)

This data is used to set the detecting range of speed detecting signal (SDTA).
When the motor speed reaches (setting data/10) % or less of maximum speed, the bit of speed arrival signal (SDTA) is set to ”1”.

0	15	15*i*	16*i*/16	
6524 6664	3024 3164	3024	4024	Speed zero detecting level

Data unit : 0.01%
Data range : 0 to 10000 (0 to 100%)
Standard setting : 75 (0.75%)

This data is used to set the detecting range of speed zero detection signal (SSTA).
When the motor speed reaches (setting data/100)% or less of maximum speed, the bit of speed zero detection signal (SSTA) is set to ”1”.

0	15	15*i*	16*i*/16	
6525 6665	3025 3165	3025	4025	Setting of torque limit value

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 50 (50%)

This data is used to set the torque limit value for maximum output torque when the torque limit command HIGH (TLMHA) or torque limit command LOW (TLMLA) is commanded.
Data represents limiting values when the maximum torque is assumed to be 100%.

Torque limit command LOW (TLMLA)	Torque limit command HIGH (TLMHA)	Details
0	0	No torque limitation exists.
0	1	Torque limited to the setting value of this parameter.
1	0	Torque limited to approximately half as compared with that of this parameter.
1	1	

0	15	15*i*	16*i*/16	
6526 6666	3026 3166	3026	4026	Load detecting level 1

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 83 (83%)
This data is used to set the detecting range of load detecting signal 1 (LD T1A).
When the motor power reaches the setting data % or more of maximum power, the bit of load detecting signal 1 (LDT1A) is set to ”1”.

0	15	15*i*	16*i*/16	
6527 6667	3027 3167	3027	4027	Load detecting level 2

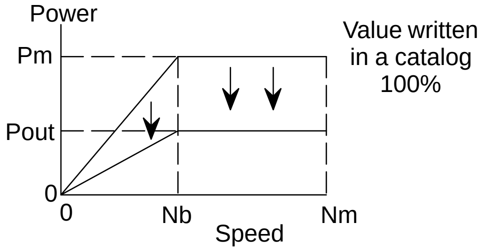
Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 95 (95%)
This data is used to set the detecting range of load detecting signal 2 (LD T2A).
When the motor power reaches the setting data % or more of maximum power, the bit of load detecting signal 2 (LDT2A) is set to ”1”.

0	15	15*i*	16*i*/16	
6528 6668	3028 3168	3028 3168	4028	Power limit pattern setting

Data unit :
Data range : 0 to 6
Standard setting : 0
Select a proper pattern from the following.
A: When the acceleration/deceleration are slowly performed by limiting the power on acceleration/deceleration only and operation is performed at rated power in normal rotation: (Setting data: 1 or 4)
(The function is similar to the soft start/stop.)
B: When the acceleration/deceleration are performed at the maximum power and the power is limited in normal rotation: (Setting data: 2 or 5)
C: When a machine with different power specifications is produced using the same motor and amplifier: (Setting data: 3 or 6)

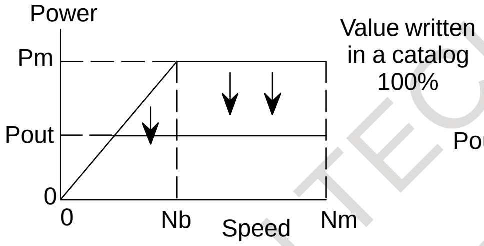
Details	Setting data	
	Pattern 1	Pattern 2
Power is not limited.	0	0
A. Power is limited on acceleration/deceleration only.	1	4
B. Power is not limited on acceleration/ deceleration and it is limited on normal rotation.	2	5
C. Power is limited over all operations.	3	6

[Power limit pattern 1] Setting data = 1, 2, 3



$$\text{Pout} = \frac{\text{Setting value of parametr (No. 4029)}}{100} \times \text{Pm}$$

[Power limit pattern 2] Setting data = 4, 5, 6



$$\text{Pout} = \frac{\text{Setting value of parametr (No. 4029)}}{100} \times \text{Pm}$$

0	15	15*i*	16*i*/16	
6529 6669	3029 3169	3029	4029	Power limit value

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 100

This data is used to set the value limited when the maximum power (allowable overload capacity) is 100%.

This setting value is valid when power is limited by setting the data on parameter No.4028.

Power limit value = Maximum power × (Setting data)%

0	15	15*i*	16*i*/16	
6530 6670	3030 3170	3030	4030	Soft start/stop setting time

Data unit : 1 min^{-1}/sec
(when parameter No. 4006 #2 (SPDUNT) = 1, 10 min^{-1})

Data range : 0 to 32767

Standard setting : 0 (0 min^{-1}/sec)

This data is used to set the time constant of soft start/stop function is available (the soft start/stop signal SOCNA = 1). When set data is 0 the soft start/stop function is not effective.

0	15	15*i*	16*i*/16	
6531 6671	3031 3171	3031	4031	Position coder method orientation stop position

Data unit : 1 pulse (360°/4096)

Data range : 0 to 4095

Standard setting : 0

This data is used to set the stop position of position coder method spindle orientation.
It can be set at every 360 degrees/4096.
When stop position external command type spindle orientation is set, this parameter becomes invalid.
12bit stop position command (SHA11 to SHA00) instructed by PMC becomes valid.

0	15	15*i*	16*i*/16	
6532	3032 6672	3032 3172	4032	Acceleration/decelerationtime constant at spindle synchronization control

Data unit : 1 min^{-1}/sec
(when parameter No. 4006 #2 (SPDUNT) = 1, 10 min^{-1})

Data range : 0 to 32767

Standard setting : 0 (0 min^{-1}/sec)

When the synchronization speed command at spindle synchronization control is changed, set the acceleration/deceleration time constant.
When set data is 0, time constant does not function.
Set exactly the same data for 1st spindle and 2nd spindle.

0	15	15*i*	16*i*/16	
6533 6673	3033 3173	3033	4033	Spindle synchronization speed arrival level

Data unit : 1 min^{-1}
(when parameter No. 4006 #2 (SPDUNT) = 1, 10 min^{-1})

Data range : 0 to 32767

Standard setting : 10 (10 min^{-1})

For the synchronization speed command at spindle synchronization control, if the deviations of the respective spindle motor speeds are within the setting level, the spindle synchronization speed control complete signal (FSPSY) becomes ”1”.

0	15	15*i*	16*i*/16	
6534 6674	3034 3174	3034	4034	Shift amount at spindle phase synchronization control

Data unit : 1 pulse (360°/4096)

Data range : 0 to 4095

Standard setting : 0 (0 pulse)

Sets the shift amount from the reference point at spindle phase synchronization control (1 rotation signal).

0	15	15*i*	16*i*/16	
6535 6675	3035 3175	3035	4035	Spindle phase synchronization compensation data

Data unit : pulse/2 msec

Data range : 0 to 4095

Standard setting : 10

This parameter reduces speed fluctuations when aligning phase of spindles in spindle phase synchronization control.
When this parameter is ”0”, since the phase alignment amount is only issued once, the position deviation quickly becomes large, and there are large speed changes on phase alignment.
It is possible to perform smooth phase alignments through issuing separate commands for phase alignment amounts for the number of 2 msec pulses set in this parameter.

0	15	15*i*	16*i*/16	
6536 6676	3036 3176	3036	4036	Feedforward coefficient

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 0%

Set the feedforward coefficient when feedforward control is executed in servo mode (rigid tap/Cs axis control etc.) and spindle positioning.

0	15	15*i*	16*i*/16	
6537 6677	3037 3177	3037	4037	Velocity loop feedforward coefficient

Data unit :

Data range : 0 to 32767

Standard setting : 0

Set the velocity loop feedforward coefficient when feedforward control is executed in servo mode (rigid tap/spindle positioning etc.) and Cs contouring control.

0	15	15*i*	16*i*/16	
6538 6678	3038 3178	3038	4038	Spindle orientation speed

Data unit parameter : 1 min^{-1} (10 min^{-1} when bit 2 (SPDUNT) of No. 4006 is set to 1)

Data range : 0 to 32767

Standard setting : 0

This parameter sets the orientation speed at the end of the spindle.
When the function for spindle orientation with a reference switch is to be used, set this parameter.
When 0 is set for this parameter, the orientation speed is determined by parameters such as parameter No. 4076.

0	15	15*i*	16*i*/16	
6540 6680	3040 3180	3040	4040	Velocity loop proportional gain on normal operation (HIGH gear) CTH1A = 0
6541 6681	3041 3181	3041	4041	Velocity loop proportional gain on normal operation (LOW gear) CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This data is used to set the velocity loop proportional gain on normal operation.
When the clutch/gear signal (CTH1A) in the spindle control signals sent from the PMC to NC is set to ”0” and ”1”, the parameters of HIGH and LOW gears are selected, respectively.

0	15	15*i*	16*i*/16	
6542 6682	3042 3182	3042	4042	Velocity loop proportional gain on orientation (HIGH gear)!CTH1A = 0
6543 6683	3043 3183	3043	4043	Velocity loop proportional gain on orientation (LOW gear)! CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This data is used to set the velocity loop proportional gain on spindle orientation.

0	15	15*i*	16*i*/16	
6544 6684	3044 3184	3044	4044	Velocity loop proportional gain on servo mode/on synchronization control (HIGH gear) CTH1A = 0
6545 6685	3045 3185	3045	4045	Velocity loop proportional gain on servo mode/on synchronization control (LOW gear) CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This sets velocity loop proportional gain in servo mode (rigid tap/spindle positioning etc.) and in synchronization control.

0	15	15*i*	16*i*/16	
6546 6686	3046 3186	3046	4046	Velocity loop proportional gain in Cs contouring control (HIGH gear) CTH1A = 0
6547 6687	3047 3187	3047	4047	Velocity loop proportional gain in Cs contouring control (LOW gear) CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 30

This sets the velocity loop proportional gain in Cs contouring control.

0	15	15*i*	16*i*/16	
6548 6688	3048 3188	3048	4048	Velocity loop integral gain on normal operation (HIGH gear) CTH1A = 0
6549 6689	3049 3189	3049	4049	Velocity loop integral gain on normal operation (LOW gear) CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This data is used to set the velocity loop integral gain on normal operation.

0	15	15*i*	16*i*/16	
6550 6690	3050 3190	3050	4050	Velocity loop integral gain on orientation (HIGH gear) CTH1A = 0
6551 6691	3051 3191	3051	4051	Velocity loop integral gain on orientation (LOW gear) CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This data is used to set the velocity loop integral gain on spindle orientation.

0	15	15*i*	16*i*/16	
6552 6692	3052 3192	3052	4052	Velocity loop integral gain on servo mode/on synchronization control (HIGH gear) CTH1A = 0
6553 6693	3053 3193	3053	4053	Velocity loop integral gain on servo mode/on synchronization control (LOW gear) CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 10

This sets velocity loop integral gain in servo mode (rigid tap/spindle positioning etc.) and in synchronization control.

0	15	15*i*	16*i*/16	
6554 6694	3054 3194	3054	4054	Velocity loop integral gain in Cs contouring control (HIGH gear) CTH1A = 0
6555 6695	3055 3195	3055	4055	Velocity loop integral gain in Cs contouring control (LOW gear) CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 50

This sets the velocity loop integral gain in Cs contouring control.

0	15	15*i*	16*i*/16		
6556 6696	3056 3196	3056	4056	Gear ratio (HIGH)	CTH1A = 0, CTH2A = 0
6557 6697	3057 3197	3057	4057	Gear ratio (MEDIUM HIGH)	CTH1A = 0, CTH2A = 1
6558 6698	3058 3198	3058	4058	Gear ratio (MEDIUM LOW)	CTH1A = 1, CTH2A = 0
6559 6699	3059 3199	3059	4059	Gear ratio (LOW)	CTH1A = 1, CTH2A = 1

Data unit : Motor rotation for one rotation of spindle × 100 (When parameter No. 4006 #1 (GRUNIT) is 1, motor rotation × 1000)

Data range : 0 to 32767

Standard setting : 100 (Gear ratio=1:1)

These data are used to set the gear ratio between spindle and spindle motor.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A, CTH2A) in the spindle control signals sent from the PMC to NC.
This parameter does not affect the motor speed during normal rotation.
(Example) When the spindle rotates once, set "250" as the data when the motor rotates 2.5 times.

0	15	15*i*	16*i*/16	
6560 6700	3060 3200	3060	4060	Position gain on orientation (HIGH) CTH1A = 0, CTH2A = 0
6561 6701	3061 3201	3061	4061	Position gain on orientation (MEDIUM HIGH) CTH1A = 0, CTH2A = 1
6562 6702	3062 3202	3062	4062	Position gain on orientation (MEDIUM LOW) CTH1A = 1, CTH2A = 0
6563 6703	3063 3203	3063	4063	Position gain on orientation (LOW) CTH1A = 1, CTH2A = 1

Data unit : 0.01 sec^{-1}
Data range : 0 to 32767
Standard setting : 1000
These data are used to set the position gain on spindle orientation.

0	15	15*i*	16*i*/16	
6564 6704	3064 3204	3064	4064	Modification rate of position gain on orientation completion

Data unit : 1%
Data range : 0 to 1000
Standard setting : 100 (100%)
This data is used to set the modification rate of position gain on spindle orientation completion.

0	15	15i	16i/16	
6565 6705	3065 3205	3065	4065	Position gain on servo mode/on synchronization control (HIGH) CTH1A = 0, CTH2A = 0
6566 6706	3066 3206	3066	4066	Position gain on servo mode/on synchronization control (MEDIUM HIGH) CTH1A = 0, CTH2A = 1
6567 6707	3067 3207	3067	4067	Position gain on servo mode/on synchronization control (MEDIUM LOW) CTH1A = 1, CTH2A = 0
6568 6708	3068 3208	3068	4068	Position gain on servo mode/on synchronization control (LOW) CTH1A = 1, CTH2A = 1

Data unit : 0.01 sec $^{-1}$
Data range : 0 to 32767
Standard setting : 1000
This sets position gain in servo mode (rigid tap/spindle positioning etc.) and in synchronization control.

0	15	15i	16i/16	
6569 6709	3069 3209	3069	4069	Position gain in Cs contouring control (HIGH) CTH1A = 0, CTH2A = 0
6570 6710	3070 3210	3070	4070	Position gain in Cs contouring control (MEDIUM HIGH) CTH1A = 0, CTH2A = 1
6571 6711	3071 3211	3071	4071	Position gain in Cs contouring control (MEDIUM LOW) CTH1A = 1, CTH2A = 0
6572 6712	3072 3212	3072	4072	Position gain in Cs contouring control (LOW) CTH1A = 1, CTH2A = 1

Data unit : 0.01 sec $^{-1}$
Data range : 0 to 32767
Standard setting : 3000
This sets the position gain in Cs contouring control.

0	15	15i	16i/16	
6573 6713	3073 3213	3073	4073	Grid shift amount in servo mode

Data unit : 1 pulse unit (360°/4096)
Data range : 0 to 4095
Standard setting : 0
Set this parameter when shifting reference point in servo mode (rigid tap/spindle postioning etc.).
In + data, spindle reference point shifts for set pulse in CCW direction.

0	15	15*i*	16*i*/16	
6574 6714	3074 3214	3074	4074	Speed for return to reference position in Cs contouring control/servo mode

Data unit : min^{-1}
Data range : 0 to 32767
Standard setting : 0
When this parameter is set to 0

In returning to the reference position in Cs contouring control, the feedrate set in the parameter (No. 4021) for specifying the maximum feedrate for Cs contouring control is used. When a high feedrate is used in returning to the reference position, set a desired feedrate in this parameter.
In returning to the reference position in the servo mode (spindle positioning/rigid tapping), the feedrate determined by the spindle orientation mode feedrate limit parameter (No. 4076) is used. When a high feedrate is used in returning to the reference position, set a desired feedrate in this parameter.

When this parameter is set to a value other than 0

In returning to the reference position in Cs contouring control/servo mode, the spindle feedrate in this parameter is used.

0	15	15*i*	16*i*/16	
6575 6715	3075 3215	3075	4075	Orientation completion signal detection level

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.1 degree unit
Data range : 0 to 100
Standard setting : 10
This data is used to set the detecting level of orientation completion signal (ORARA).
When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORARA) in the spindle control signals is set to "1".

0	15	15*i*	16*i*/16	
6576 6716	3076 3216	3076	4076	Motor speed limit value on orientation

Data unit : 1%
Data range : 0 to 100
Standard setting : 33
This data is used to set the motor speed limit value on orientation.
Speed limit value = Orientation speed of motor × (Setting data)/100 min^{-1}
Orientation speed of motor = Position gain × Gear ratio × 60 min^{-1}

0	15	15*i*	16*i*/16

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.01 degree unit

6577 6717	3077 3217	3077	4077	Orientation stop position shift value

Data range : Position coder method → – 4095 to 4095
Magnetic sensor method → –100 to 100

Standard setting : 0

In the position coder method orientation, set this data to shift stop position.

Spindle is shift No. of setting pulse in CCW direction, and stops by data (+).

This data is used to set the position shift amount from the position where the magnetic sensor faces the magnetizing element on magnetic sensor method orientation stop.

The spindle is shifted in CCW direction by data (+).

0	15	15*i*	16*i*/16	
6578 6718	3078 3218	3078	4078	MS signal constant = (L/2)/(2×π×H)×4096

L: Length of magnetizing element (mm)

H: Distance from spindle center to magnetizing element (mm)

Data unit :

Data range : 80 to 1000

Standard setting : 200

In the magnetic sensor method orientation, substitute the followings into the expression above to set the MS signal constant.

L: Length of magnetizing element (mm)

H: Distance from spindle center to magnetizing element (mm)

0	15	15*i*	16*i*/16	
6579 6719	3079 3219	3079	4079	MS signal gain adjustment

Data unit :

Data range : –128 to +127

Standard setting : 0

Use this parameter when adjusting the amplitude of the MS signal in the magnetic sensor method orientation.

0	15	15*i*	16*i*/16		
6580 6720	3080 3220	3080	4080	Limitation of regenerative power	Conventional
				Limitation of regenerative power	HRV

Usually, set the standard value for the motor being used.

If a value greater than the standard value is set, a power circuit device may be damaged by an excessive load.

0	15	15*i*	16*i*/16	
6581 6721	3081 3221	3081	4081	Delay time until the motor power is cut off

Data unit : 10 ms

Data range : 0 to 1000

Standard setting : 20 (200 ms)

The motor power is cut off after stopping the motor (zero speed detection signal SSTA = 1 is detected).
However, when the power is cut off immediately after detecting the zero speed signal, the motor may be operated at low speed due to force of habit. Detect the zero speed signal and then set the time until the motor power is cut off by this parameter.

0	15	15*i*	16*i*/16	
6582 6722	3082 3222	3082	4082	Time setting during acceleration/deceleration

Data unit : 1 sec

Data range : 0 to 255

Standard setting : 10 (10 sec)

When the deviation between the velocity command and motor speed exceeds the setting level, an velocity error excess alarm (AL-02) occurs. However, if the velocity command is changed during acceleration/deceleration, the motor speed cannot follow it. Thus, a velocity error excess alarm (AL-02) occurs.
In this case, set the acceleration/deceleration time for preventing velocity error excess alarm from occurring even if there is a speed error during the time set by this parameter.
When the lathe load inertia is large, the acceleration/deceleration time becomes longer. Thus, set the value accordingly.

0	15	15*i*	16*i*/16	
6583 6723	3083 3223	3083	4083	Motor voltage setting on normal rotation
6584 6724	3084 3224	3084	4084	Motor voltaage setting on orientation
6585 6725	3085 3225	3085	4085	Motor voltage setting on servo mode/on synchronization control
6586 6726	3086 3226	3086	4086	Motor voltage setting in Cs contouring control

Data unit : 1%

Data range : 0 to 100

Standard setting : Depends on the motor model

When performing rigid tapping, usually set the motor voltage to 100 in servo mode.
Set the motor voltage to "100", when Cs contouring control is in operation.
Set parameter No. 4016 #4 (CMTVL) is "1", when the motor voltage during Cs contouring control is set for less than "100".

0	15	15*i*	16*i*/16	
6587 6727	3087 3227	3087	4087	Overspeed level (OVSDT)

Data unit : 1%
Data range : 0 to 200
Standard setting : 115 (115%)

This data is used to set the overspeed level.
When the speed exceeds the value of "maximum speed (setting data) %", an overspeed alarm (AL-07) occurs.

0	15	15*i*	16*i*/16	
6588 6728	3088 3228	3088	4088	Velocity error excess detecting level on motor shaft lock condition

Data unit : 0.01%
Data range : 0 to 10000
Standard setting : 75 (0.75%)

This data is used to set the velocity error excess detecting level on motor shaft lock condition.
When the motor is locked and the velocity error exceeds the value of "maximum speed (setting data)%", a motor shaft lock alarm (AL-31) occurs.

0	15	15*i*	16*i*/16	
6589 6729	3089 3229	3089	4089	Velocity error excess detecting level on motor rotation

Data unit : 0.1%
Data range : 0 to 1000
Standard setting : 200

This data is used to set the velocity error excess detecting level on motor rotation.
When the velocity error exceeds the value of "maximum speed (setting data) %", a velocity error excess alarm (AL-02) occurs.

0	15	15*i*	16*i*/16	
6590 6730	3090 3230	3090	4090	Overload detecting level

Data unit : 1%
Data range : 0 to 100
Standard setting : 90

This data is used to set the overload detecting level.
When the motor load remains to be equal to or more than the value of ”maximum power (setting data)%” for a long time, a short-time overload alarm (AL-29) occurs.

0	15	15*i*	16*i*/16	
6591 6731	3091 3231	3091	4091	The reduction rate of position loop gain in returning to the reference point on servo mode

Data unit : 1%
Data range : 0 to 100
Standard setting : 100

This sets the reduction rate of position gain in returning to the reference point in servo mode (rigid tap/spindle positioning etc.)

0	15	15*i*	16*i*/16	
6592 6732	3092 3232	3092	4092	The reduction rate of position loop gain in returning to the reference point on Cs contouring mode

Data unit : 1%
Data range : 0 to 100
Standard setting : 100

This sets the reduction rate of position gain in returning to the reference point in Cs contouring control.

0	15	15*i*	16*i*/16	
6594 6734	3094 3234	3094	4094	The constant of the torque disturbance compensating

Data unit :
Data range : 0 to 32767
Standard setting : 0

This sets a constant when compensating for torque disturbance in Cs contouring control.

0	15	15*i*	16*i*/16	
6595 6735	3095 3235	3095	4095	Adjustment of speed meter output voltage

Data unit : 0.1%
Data range : –1000 to +100 (–100% to +10%)
Standard setting : 0
This parameter is set when carrying out minute adjustments of speed meter output voltage.
Output voltage becomes large in + data.

0	15	15*i*	16*i*/16	
6596 6736	3096 3236	3096	4096	The adjustment of load meter output voltage

Data unit : 0.1%
Data range : –1000 to +100 (–100% to +10%)
Standard setting : 0
This parameter is set when carrying out minute adjustments of load meter output voltage.
Output voltage becomes large in + data.

0	15	15*i*	16*i*/16	
6597 6737	3097 3237	3097	4097	Spindle speed feedback gain

Data unit : 0
Data range : 0 to 32767
Standard setting : 0
This parameter is set to feed back spindle speed and compensate for torque disturbance in Cs contouring control in systems where spindles and spindle motors are linked by gears or belts.

0	15	15*i*	16*i*/16	
6598 6738	3098 3238	3098	4098	Maximum speed of position coder signal detection

Data unit : 1 min^{-1}
(When parameter No. 4006 #2 (SPDUNT) =1, 10 min^{-1})
Data range : 0 to 32767
Standard setting : 0
Parameter for setting the maximum speed of position coder signal detections possible.
If the parameter is set to ”0”, the speed of detections possible is the same as the maximum speed for the motor.

0	15	15*i*	16*i*/16

Data unit : 1 ms
Data range : 0 to 32767

6599 6739	3099 3239	3099	4099	Delay time for motor excitation

Standard setting : 0

Parameter for setting the time until motor excitation is stable in rigid tap and Cs contouring control modes.

0	15	15*i*	16*i*/16		
6600 6740	3100 3240	3100	4100	Base speed of motor power specifications	Conventional
				Base speed of motor power specifications	HRV

0	15	15*i*	16*i*/16		
6601 6741	3101 3241	3101	4101	Limit value for motor power specifications	Conventional
				Torque limit value for motor power specifications	HRV

0	15	15*i*	16*i*/16		
6602 6742	3102 3242	3102	4102	Base speed	Conventional
				Activating voltage saturation speed at no–load	HRV

0	15	15*i*	16*i*/16		
6603 6743	3103 3243	3103	4103	Magnetic flux down start speed	Conventional
				Base speed limit ratio	HRV

0	15	15*i*	16*i*/16		
6604 6744	3104 3244	3104	4104	Current loop proportional gain data	Conventional
				Current loop proportional gain data	HRV

0	15	15*i*	16*i*/16		
6605 6745	3105 3245	3105	4105	Current loop proportional gain data (in Cs contouring control)	Conventional
					HRV

0	15	15*i*	16*i*/16		
6606 6746	3106 3246	3106	4106	Current loop integral gain data	Conventional
				Current loop integral gain data	HRV

0	15	15*i*	16*i*/16		
6607 6747	3107 3247	3107	4107	Current loop integral gain data (in Cs contouring control)	Conventional
					HRV

0	15	15*i*	16*i*/16		
6608 6748	3108 3248	3108	4108	Current loop integral gain zero point	Conventional
				Current loop integral gain zero point	HRV

0	15	15*i*	16*i*/16	Description	Type
6609	3109	3109	4109	Current loop proportional gain speed coefficient	Conventional
6749	3249			Filter time constant for processing saturation related to the voltage command	HRV

0	15	15*i*	16*i*/16	Description	Type
6610	3110	3110	4110	Current conversion constant	Conventional
6750	3250			Current conversion constant	HRV

0	15	15*i*	16*i*/16	Description	Type
6611	3111	3111	4111	Secondary current coefficient for excitation current	Conventional
6751	3251			Secondary current coefficient	HRV

0	15	15*i*	16*i*/16	Description	Type
6612	3112	3112	4112	Current prediction constant	Conventional
6752	3252			Criterion level for saturation related to the voltage command/PWM command clamp value	HRV

0	15	15*i*	16*i*/16	Description	Type
6613	3113	3113	4113	Slip constant	Conventional
6753	3253			Slip constant	HRV

0	15	15*i*	16*i*/16	Description	Type
6614	3114	3114	4114	Slip compensation constant of high-speed rotation	Conventional
6754	3254			Slip compensation coefficient for a high–speed zone/slip compensation coefficient at deceleration	HRV

0	15	15*i*	16*i*/16	Description	Type
6615	3115	3115	4115	Motor applied voltage compensation constant by dead time	Conventional
6755	3255			PWM command clamp value at deceleration	HRV

0	15	15*i*	16*i*/16	Description	Type
6616	3116	3116	4116	Electromotive voltage compensation coefficient	Conventional
6756	3256			Motor leakage constant	HRV

0	15	15*i*	16*i*/16		
6617 6757	3117 3257	3117	4117	Electromotive voltage phase compensation coefficient	Conventional
				Regular–time voltage compensation coefficient for high–speed zone/regular–time motor voltage coefficient	HRV

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16		
6618 6758	3118 3258	3118	4118	Electromotive voltage compensation speed coefficient	Conventional
				Acceleration–time voltage compensation coefficient for high–speed zone/acceleration–time motor voltage coefficient	HRV

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16		
6619 6759	3119 3259	3119	4119	Time constant for voltage filter used for electromotive force compensation	Conventional
				Deceleration–time activating current change time constant/ activating current change time constant	HRV

Data unit : 1 ms
Data range : 0 to 8191
Standard setting : 0

0	15	15*i*	16*i*/16		
6620 6760	3120 3260	3120	4120	Dead time compensation data	Conventional
				Rectangular–wave component zero voltage/dead–zone compensation data	HRV

Data unit :
Data range : 0 to 100
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16	
6621 6761	3121 3261	3121	4121	Time constant of torque change

Data unit : 1 ms
Data range : 0 to 1000
Standard setting : 5

0	15	15*i*	16*i*/16	
6622 6762	3122 3262	3122	4122	Speed detection filter time constant

Data unit : 0.1 ms
Data range : 0 to 10000
Standard setting : 0

0	15	15*i*	16*i*/16	
6623 6763	3123 3263	3123	4123	Overload detecting time

Data unit : 1 sec
Data range : 0 to 500
Standard setting : 30

0	15	15*i*	16*i*/16		
6624 6764	3124 3264	3124	4124	Voltage compensation coefficient for deceleration	Conventional
					HRV

0	15	15*i*	16*i*/16	
6625 6765	3125 3265	3125	4125	Timer setting for automatic operation

Data unit : 0.1 sec
Data range : 0 to 32767
Standard setting : 0

0	15	15*i*	16*i*/16	
6626 6766	3126 3266	3126	4126	Velocity command on automatic operation

Data unit : 1 min^{-1}
(when parameter No. 4006 #2 (SPDUNT) = 1, 10 min^{-1})
Data range : 0 to maximum speed of motor
Standard setting : 0

0	15	15*i*	16*i*/16		
6627 6767	3127 3267	3127	4127	Load meter display value on maximum power	Conventional
				Load meter display value on maximum power	HRV

0	15	15*i*	16*i*/16		
6628 6768	3128 3268	3128	4128	Maximum power limit zero point	Conventional
				Maximum torque curve compensation coefficient	HRV

0	15	15*i*	16*i*/16		
6629 6769	3129 3269	3129	4129	Secondary electrical current coefficient on rigid tap	Conventional
				Secondary electrical current coefficient on rigid tap	HRV

0 15 15*i* 16*i*/16

0	15	15*i*	16*i*/16	
6630 6770	3130 3270	3130	4130	Electromotive voltage phase compensation constant on deceleration Current loop proportional gain speed coefficient/current phase delay compensation coefficient

0	15	15*i*	16*i*/16	
6631 6771	3131 3271	3131	4131	Speed detection filter time constant (on Cs contouring control)

Data unit : 0.1ms
Data range : 0 to 10000
Standard setting : 0

0	15	15*i*	16*i*/16	
6632 6772	3132 3272	3132	4132	V-phase current conversion constant

Data unit :
Data range : 0 to 32767
Standard setting : 0

0	15	15*i*	16*i*/16	
6633 6773	3133 3273	3133	4133	Motor model code

Data unit :
Data range :
Standard setting : Depends on the motor model.

Set the model code when automatic setting the first parameters of the spindle motor.
At this time it is necessary to set the following parameters simultaneously.
Series 0 : Parameter PRLOAD (No.6519#7)=1
Series 15/15**i** : Parameter PRLOAD (No.5607#0)=0
Series 16/16**i** : Parameter PRLOAD (No.4019#7)=1

0	15	15*i*	16*i*/16	
6635 6775	3135 3275	3135	4135	Grid shift amount in Cs contouring control (LONG WORD)

Data unit : Number of pulses (0.001 degrees)
Data range : –360000 to +360000
Standard setting : 0

Set the pulse from one rotation signal to machine zero point in Cs contouring control.

3.2 LOW SPEED RANGE PARAMETERS FOR SPEED RANGE SWITCHING CONTROL

0	15	15*i*	16*i*/16	
6900 6940	3280 3500	3136	4136	Motor voltage setting on normal rotation

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16	
6901 6941	3281 3501	3137	4137	Motor voltage setting on servo mode/on synchronization control

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16		
6902 6942	3282 3502	3138	4138	Base speed of motor power specifications	Conventional
				Base speed of motor power specifications	HRV

0	15	15*i*	16*i*/16		
6903 6943	3283 3503	3139	4139	Limit value for motor power specifications	Conventional
				Torgue limit value for motor power specifications	HRV

0	15	15*i*	16*i*/16		
6904 6944	3284 3504	3140	4140	Base speed	Conventional
				Activating voltage saturation speed at no–load	HRV

0	15	15*i*	16*i*/16		
6905 6945	3285 3505	3141	4141	Magnetic flux down start speed	Conventional
				Base speed limit ratio	HRV

0	15	15*i*	16*i*/16		
6906 6946	3286 3506	3142	4142	Current loop proportional gain data	Conventional
				Current loop proportional gain data	HRV

0 15 15*i* 16*i*/16

0	15	15*i*	16*i*/16		
6907	3287	3143	4143	Current loop integral gain data	Conventional
6947	3507			Current loop integral gain data	HRV

0	15	15*i*	16*i*/16		
6908	3288	3144	4144	Current loop integral gain zero point	Conventional
6948	3508			Current loop integral gain zero point	HRV

0	15	15*i*	16*i*/16		
6909	3289	3145	4145	Current loop proportional gain speed coefficient	Conventional
6949	3509			Filter time constant for processing saturation related to the voltage command	HRV

0	15	15*i*	16*i*/16		
6910	3290	3146	4146	Current conversion constant	Conventional
6950	3510			Current conversion constant	HRV

0	15	15*i*	16*i*/16		
6911	3291	3147	4147	Secondary current coefficient for excitation current	Conventional
6951	3511			Secondary current coefficient	HRV

0	15	15*i*	16*i*/16		
6912	3292	3148	4148	Current prediction constant	Conventional
6952	3512			Criterion level for saturation related to the voltage command/PWM command clamp value	HRV

0	15	15*i*	16*i*/16		
6913	3293	3149	4149	Slip constant	Conventional
6953	3513			Slip constant	HRV

0	15	15*i*	16*i*/16		
6914	3294	3150	4150	Slip compensation constant of high-speed rotation	Conventional
6954	3514			Slip compensation coefficient for a high–speed zone/slip compensation coefficient at deceleration	HRV

0	15	15*i*	16*i*/16		
6915	3295	3151	4151	Motor applied voltage compensation constant by dead time	Conventional
6955	3515			PWM command clamp value at deceleration	HRV

0	15	15*i*	16*i*/16		
6916	3296	3152	4152	Electromotive voltage compensation coefficient	Conventional
6956	3516			Motor leakage constant	HRV

0	15	15*i*	16*i*/16		
6917 6957	3297 3517	3153	4153	Electromotive voltage phase compensation coefficient	Conventional
				Regular–time voltage compensation coefficient for high–speed zone/regular–time motor voltage coefficient	HRV

0	15	15*i*	16*i*/16		
6918 6958	3298 3518	3154	4154	Electromotive voltage compensation speed coefficient	Conventional
				Acceleration–time voltage compensation coefficient for high–speed zone/acceleration–time motor voltage coefficient	HRV

0	15	15*i*	16*i*/16		
6919 6959	3299 3519	3155	4155	Voltage compensation coefficient for deceleration	Conventional
					HRV

0	15	15*i*	16*i*/16	
6921 6961	3301 3521	3157	4157	Time constant of torque change

Data unit : 1ms
Data range : 0 to 1000
Standard setting : 5

0	15	15*i*	16*i*/16		
6922 6962	3302 3522	3158	4158	Maximum power limit zero point	Conventional
				Maximum torque curve compensation coefficient	HRV

0	15	15*i*	16*i*/16		
6923 6963	3303 3523	3159	4159	Secondary electrical current coefficient on rigid tap	Conventional
				Secondary electrical current coefficient on rigid tap	HRV

0	15	15*i*	16*i*/16	
6924 6964	3304 3524	3160	4160	Speed detection level hysteresis

Data unit : 1 min^{-1}
(when parameter No. 4006 #2 (SPDUNT) = 1, 10 min^{-1})
Data range : 0 to 32767
Standard setting : 0

Set the hysteresis for the speed detection level.
The speed detection level is set by parameter. The speed detection signal (SDT) changes from 1 to 0 with the set speed detection level + hysteresis number of revolutions, and changes from 0 to 1 with the set speed detection level number of revolutions. If this data is set to 20 min^{-1} or less, the hysteresis is automaitcally set to 20 min^{-1}.
If the speed detection signal (SDT) is used in speed range switching control, increase the data setting in situations where the switching circuit is likely to cause chattering close to the number of revolutions for the speed detection level.

0	15	15*i*	16*i*/16		
6925 6965	3305 3525	3161	4161	Electromotive voltage phase compensation constant on deceleration	Conventional
				Current loop proportional gain speed coefficient/current phase delay compensation coefficient	HRV

0	15	15*i*	16*i*/16	
6926 6966	3306 3526	3162	4162	Velocity loop integral gain on Cs contouring control cutting feed (HIGH) CTH1A = 0
6927 6967	3307 3527	3163	4163	Velocity loop integral gain on Cs contouring control cutting feed (LOW) CTH1A = 1

Data unit :
Data range : 0 to 32767
Standard setting : 0

Set the velocity loop integral gain when cutting feed (G01, G02, G03) is operating in the Cs contouring control mode.
When the data is ”0”, parameters (No. 4054 and 4055) data become valid.

0	15	15*i*	16*i*/16	
6928	3308	3164	4164	V-phase current conversion constant

Data unit :
Data range : 0 to 32767
Standard setting : 0

0	15	15*i*	16*i*/16		
6929 6969	3309 3529	3165	4165	Time constant for voltage filter used for electromotive force compensation	Conventional
				Deceleration–time activating current change time constant/ activating current change time constant	HRV

0	15	15*i*	16*i*/16		
6930 6970	3310 3530	3166	4166	Regenerative power limit	Conventional
				Regenerative power limit for high–speed zone/regenerative power limit/Regenerative power limit	HRV

0	15	15*i*	16*i*/16	
6932 6972	3312 3532	3168	4168	Overload current alarm detection level (for low-speed range)

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16	
6933 6973	3313 3533	3169	4169	Overload current alarm detection time constant

0	15	15*i*	16*i*/16	
6934 6974	3314 3534	3170	4170	Overload current alarm detection level (for high-speed range)

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16		
6935 6975	3315 3535	3171	4171	Number of spindle gear teeth (HIGH)	CTH1A=0
6936 6976	3316 3536	3172	4172	Number of position detector gear teeth (HIGH)	CTH1A=0
6937 6977	3317 3537	3173	4173	Number of spindle gear teeth (LOW)	CTH1A=1
6938 6978	3318 3538	3174	4174	Number of position detector gear teeth (LOW)	CTH1A=1

Data unit :
Data range : 0 to 32767
Standard setting : 0

These parameters set an arbitrary gear ratio between the spindle and position detector (position coder).

These parameters are used when the function for spindle orientation with a reference switch is used (when bit 3 (PCGEAR) of parameter No. 4009 is 1).

When bit 3 (PCGEAR) of parameter No. 4009 is 1, 1 is assumed, even if 0 is set for these parameters.

3.3 SUB SPINDLE PARAMETERS FOR SPINDLE SWITCHING CONTROL

0	15	15i	16i/16	#7	#6	#5	#4	#3	#2	#1	#0
6140 6320	3320 3540	3176	4176				RETSV		POSC1		ROTA1
Standard setting:				0	0	0	0	0	0	0	0

ROTA1: Indicates the relationship between the rotation directions of spindle and spindle motor.

0: Rotates the spindle and spindle motor in the same direction.

1: Rotates the spindle and spindle motor in the reverse direction.

POSC1: Indicates the mounting direction of position coder.

0: Rotates the spindle and position coder in the same direction.

1: Rotates the spindle and position coder in the reverse direction.

RETSV: Indicates reference point return direction (rigid tap/spindle positioning etc.) when in servo mode.

0: Spindle reference point returns CCW (counter clockwise)

1: Spindle reference point returns CW (clockwise)

0	15	15i	16i/16	#7	#6	#5	#4	#3	#2	#1	#0
6141 6321	3321 3541	3177	4177					MGSEN	POSC2		MRDY1
Standard setting:				0	0	0	0	0	0	0	1

MRDY1: Determines whether the MRDYA signal (machine ready signal) is used or not.

0: Not used. (The MRDYA signal should be always set to 1.)

1: Used.

POSC2: Determines whether the position coder signal is used or not.

0: Not used.

1: Used.

MGSEN: Indicates the mounting direction of magnetic sensor.

0: Rotates the motor and magnetic sensor in the same direction.

1: Rotates the motor and magnetic sensor in the reverse direction.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6142 6322	3322 3542	3178	4178			SVMDRT					

Standard setting:	0	0	0	0	0	0	0	0

SVMDRT:

Rotation direction signal (SFR/SRV) function setting when in servo mode (rigid tap/spindle positioning)

0: Rotation direction function present

With a + motion command, spindle rotation is CCW when SFR=1 spindle rotation is CW when SRV=1

1: Rotation direction function absent

With a + motion command, spindle rotation is CCW when SFR=1 or SRV=1

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6143 6323	3323 3543	3179	4179	PCPL2	PCPL1	PCPL0	PCTYPE	DIRCT2	DIRCT1	PCCNCT	PCMGSL

Standard setting:	0	0	0	0	0	0	0	0

PCMGSL:

Selection of position coder method/magnetic sensor method spindle orientation

0: Position coder method spindle orientation function

1: Magnetic sensor method spindle orientation function

PCCNCT:

Specifies whether a MZ sensor or BZ sensor (built–in motor) in a motor is used.

0: Not used.

1: Used.

Set this bit to 1 when a MZ sensor (built–in sensor) in a motor is used. Also, set this bit to 1 when a built–in motor's BZ sensor (built–in sensor) is used.

DIRCT2–DIRCT1:

Setting of rotation direction at spindle orientation

DIRCT2	DIRCT1	Rotation direction at spindle orientation
0	0	By rotation direction immediately before
0	1	By rotation direction immediately before
1	0	CCW (counterclockwise direction) looking from shaft of motor
1	1	CW (clockwise direction) looking from shaft of motor

PCPL1, PCPL2, PCPL0, PCTYPE:

Set a position coder signal.

PCPL2	PCPL1	PCPL0	PCTYPE	MZ sensor, BZ sensor (Built–in sensor)	Others
0	0	0	0	256 λ/rev (φ103)	Position coder
0	0	0	1	128 λ/rev (φ52)	—

PCPL2	PCPL1	PCPL0	PCTYPE	MZ sensor, BZ sensor (Built–in sensor)	Others
0	1	0	0	512 λ/rev (φ205)	—
0	1	0	1	64 λ/rev (φ26)	—
1	1	0	0	384 λ/rev (φ154)	—

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6144 6324	3324 3544	3180	4180				BISGAN	RFTYPE	EXTRF		

Standard setting: 0 0 0 0 0 0 0 0

EXTRF: Specifies whether a reference switch signal is used.

0: Not used.

1: Used.

RFTYPE: Specifies whether to invert the external one–turn signal.

0: The final signal is to be inverted.

1: The final signal is not to be inverted.

BISGAN:

Specifies the built–in sensor of motor model α0.5 (9D00.D).

0: Other than the case below (α0.5 (B380))

1: Motor model α0.5 (B390) with MZ sensor

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6146 6326	3326 3546	3182	4182	BLTRGD		ALGOVR			SPDUNT	GRUNIT	

Standard setting: 0 0 0 0 0 0 0 0

GRUNIT:

Gear ratio setting resolution setting

0: 1/100 units (Under normal circumstances, set to ”0”.)

1: 1/1000 units

These parameters change the following parameter settings.

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st	2nd	1st	2nd			
6180	6360	3360	3580	3216	4216	Gear ratio (HIGH)
6181	6361	3361	3581	3217	4217	Gear ratio (LOW)

SPDUNT:

Setting the unit of speed

0: 1 min^{-1} setting (”0” is usually chosen)

1: 10 min^{-1} setting

Choose ”1” for motors with a maximum min^{-1} of more than 32767.
These parameters change the following parameter settings.

Parameter No.						Description	Parameter setting unit	
0		15		**15*i***	**16*i*/16**		**1min^{-1}**	**10min^{-1}**
1st	2nd	1st	2nd					
6160	6340	3340	3560	3196	4196	Maximum speed	1min^{-1}	10min^{-1}
6220	6400	3400	3620	3256	4256	Base speed of motor power specifications	1min^{-1}	10min^{-1}
6222	6402	3402	3622	3258	4258	Base speed	1min^{-1}	10min^{-1}
6223	6403	3403	3623	3259	4259	Magnetic flux down start speed	1min^{-1}	10min^{-1}
6226	6406	3406	3626	3262	4262	Current loop integral gain zero point	1min^{-1}	10min^{-1}
6239	6419	3419	3639	3275	4275	Maximum power limit zero point	1min^{-1}	10min^{-1}
Low speed range parameters for speed range switching control (when speed range switching function exists)								
6250	6430	3430	3650	3266	4286	Base speed of motor power specifications	1min^{-1}	10min^{-1}
6252	6432	3432	3652	3288	4288	Base speed	1min^{-1}	10min^{-1}
6253	6433	3433	3653	3289	4289	Magnetic flux down start speed	1min^{-1}	10min^{-1}
6256	6436	3436	3656	3292	4292	Current loop integral gain zero point	1min^{-1}	10min^{-1}
6268	6448	3448	3668	3304	4304	Maximum power limit zero point	1min^{-1}	10min^{-1}

ALGOVR:

Setting of a spindle analog override range

0: 0% to 100%

1: 0% to 120%

BLTRGD:

Setting for rigid tapping performed using the arbitrary gear ratio (command) in a built–in MZ sensor (built-in sensor) contained in a motor

0: Any cases except following case.

1: Rigid tapping performed usingi the arbitrary gear ratio (command) in a built–in MZ sensor

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6147 6327	3327 3547	3183	4183	PHAICL	PCALCH	PCLS					

Standard setting: 0 0 0 0 0 0 0 0

PCLS : Whether the position coder signal open circuit detector (AL-27) is enabled or not.

0: Performs disconnection detection. (Normally set to 0)

1: Does not perform disconnection detection.

PCALCH:

Enables or disables detection of the alarms (AL-41, 42, 47) related to the position coder signal.

0: Detects the alarms related to the position coder signal.

1: Does not detect the alarms related to the position coder signal.

When this bit is set to 0, AL–41 (position coder one–rotation signal detection error), AL–42 (position coder one–rotation signal not detected), and AL–47 (position coder signal error) are checked. When the spindle is not connected to a position coder on a one–to–one basis, set this bit to 1 to prevent detection errors.
When 0 is set in this parameter, a specification of 100 min^{-1} is assumed.

PHAICL:

Setting of a motor voltage pattern when no loads are imposed
Usually, set this parameter to 1.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6149 6329	3329 3549	3185	4185		OVRTYP	TRSPCM	LDTOUT	PCGEAR	ALSP		VLPGAN
Standard setting:				0	0	0	0	0	0	0	0

VLPGAN:

Increment system for velocity control loop gain

0: Normal setting (Normally set to 0)

1: Processed by multiplying the normal setting data by 1/16.

ALSP: Specifies how to turn off the power to the motor when AL–24 (serial transfer data error) is issued.

0: The power to the motor is turned off once the motor has been decelerated and stopped.

1: The power to the motor is turned off immediately.

Set this bit to 1 to turn off the power to the motor immediately upon the issue of any spindle alarm.

PCGEAR:

Specifies whether the arbitrary gear ratio (between the spindle and position coder) function is used.

0: Not used.

1: Used.

Set this bit to 1 to use the function for spindle orientation (proximity switch) with a reference switch.
Set an arbitrary gear ratio in parameter Nos. 4243 to 4246.

LDTOUT:

Specifies whether the load detection signals (LDT1, LDT2) are output during acceleration/deceleration.

0: Not output during acceleration/deceleration.

1: Output (at all times) during acceleration/deceleration when the level set in the parameter is exceeded.

TRSPCM:

Specifies the method of output compensation (9D00.D).

The method varies with the motor model.

OVRTYP:

Specifies an analog override type (9D00.D).

0: Override of linear function type

1: Override of quadratic function type

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6151 6331	3331 3551	3187	4187	POLE2		ADJG	MXPW	POLE1	VDT3	VDT2	VDT1

Standard setting: X 0 X X X X X X

VDT3-VDT1:

Setting of speed detector

VDT3	VDT2	VDT1	Setting of speed detector
0	0	0	64 λ/rev
0	0	1	128 λ/rev
0	1	0	256 λ/rev
0	1	1	512 λ/rev

POLE2, POLE1:

No. of motor poles

POLE2	POLE1	No. of motor poles
0	0	2 poles
0	1	4 poles
1	0	8 poles
1	1	6 poles

(9D20)

X: Depends on the motor model.

MXPW: Settings of maximum power when accelerating and decelerating
Depends on the motor model.

ADJG: Settings of acceleration and deceleration judging conditions on maximum power when accelerating and decelerating.
Depends on the motor model.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6152 6332	3332 3552	3188	4188							PWM2	PWM1

Standard setting: 0 0 0 0 0 0 X X

X: Depends on the motor model.

PWM2 to PWM1:

Setting of PWM carrier frequency
Normally set to ”00”.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6153 6333	3333 3553	3189	4189	PWM3K	DS5	DS4	DS3	DS2	DS1		ESEC

Standard setting: 0 0 X X X X 0 0

X: Depends on the amplifier model.

ESEC : Setting of detection edge of position coder one rotation signal

0: CCW=Rising edge CW=Falling edge (Normally set to ”0”)

1: CCW, CW=Rising edge

DS5–DS1:

Set the current dead band data.

PWM3K:

Sets a PWM carrier frequency in the low–speed range when speed range switching is used.

The value to be set in this parameter varies with the motor model. Usually, set 0.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6156 6336	3336 3556	3192	4192	RFCHK3	RFCHK2			FFSMTH			

Standard setting: 0 0 0 0 0 0 0 0

FFSMTH:

Presence of smoothing function on feedforward control

1: Without smoothing function

0: With smoothing function

Sets the presence of smoothing function on feedforward control of servo mode (rigid tap, spindle positioning etc.).

RFCHK2:

Presence of 1 rotation signal error detection (AL-46) function for position coder signal

0: 1 rotation signal error detection (AL-46) function not present

1: 1 rotation signal error detection (AL-46) function present

RFCHK3:

Presence of function for redetecting the 1 rotation signal for the position coder signal each time spindle orientation/spindle synchronization control/rigid tap zero return mode is entered.

0: The 1 rotation signal is not detected each time the operating mode changes.
Once the 1 rotation signal has been detected, it is not detected again until the power goes off.

1: The 1 rotation signal is detected each time the operating mode changes.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6157 6337	3337 3557	3193	4193	NRROEN				PC1CAT	RFCHK4		

Standard setting:	0	0	0	0	0	0	0	0

RFCHK4:

Specifies whether to use the position coder 1-rotation signal detection function in normal rotation

0: Does not detect the 1-rotation signal in normal rotation.

1: Detects the 1-rotation signal in normal rotation.

PC1CAT:

Specifies whether a position coder one–rotation signal is detected during spindle orientation by a magnetic sensor.

0: Not detected.

1: Detected.

NRROEN:

Specifies whether the shortcut function is used when spindle orientation by a position coder is performed from the stopped state.

0: Not used.

1: Used.

When this bit is set to 1, the shortcut function is used when the following requirements are satisfied:

- Bit 7 (RFCHK3) of parameter No. 4192 is set to 0.
- The speed zero signal SST is set to 1.
- The shortcut command NRRO is set to 1.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6159 6339	3339 3559	3195	4195	PRLOAD		VDCV1	SDTCHG		SSTTRQ		

Standard setting:	0	0	0	0	0	0	0	0

SSTTRQ:

Specifies whether to use torque clamping at speed of 0

0: Uses clamping.

1: Does not use clamping.

SDTCHG:

Specifies whether to switch from the high–speed range to low–speed range upon the speed detection signal (SDT) being set to 1 when output switching is used.

0: Switches regardless of the speed detection signal (SDT).

1: Switches when the speed detection signal (SDT) is set to 1.

VDCV1: Specifies whether DC link voltage detection filter processing is performed.

0: Performed. (Normally set to 0)

1: Not performed.

PRLOAD:

Parameter automatic setting function (Series 0, Series 16**i**/16)

0: Parameter automatic setting is not executed.

1: Parameter automatic setting is executed.

Set the code for the motor being used in parameter No. 4309, and set this bit to 1. Then, briefly turn the CNC off, then on again. Then, the Series spindle parameters (Nos. 4176 to 4351) corresponding to the specified model code are automatically initialized. Once automatic parameter initialization has been completed, this bit is automatically reset to 0.

> **NOTE**
> For FS15/15*i*, a different parameter address, bit 0 of parameter No. 5607, is used for this function.
> Note that the setting function is reversed.
> Further, note that the parameters for the main spindle side are also initialized automatically.
> 0: Automatic parameter initialization is performed.
> 1: Automatic parameter initialization is not performed.
> Set the model code in parameter No. 3453 (No.3309 in the FS15*i*).

0	15	15*i*	16*i*/16	
6160 6340	3340 3560	3196	4196	Maximum speed

Data unit : 1 min^{-1} (when parameter No. 4182 #2 (SPDUNT) = 1, 10 min^{-1})

Data range : 0 to 32767

Standard setting : Depends on the motor model.

This data is used to set the maximum speed of spindle motor.

0	15	15*i*	16*i*/16	
6161 6341	3341 3561	3197	4197	Speed arrival detection level

Data unit : 0.1%

Data range : 0 to 1000 (0 to 100%)

Standard setting : 150 (15%)

This data is used to set the detecting range of speed arrival signal (SARA).

When the motor speed reaches the range within ±(setting data/10)% of commanded speed, the bit of speed arrival signal (SARA) is set to ”1”.

0	15	15*i*	16*i*/16	
6162 6342	3342 3562	3198	4198	Speed detecting level

Data unit : 0.1%

Data range : 0 to 1000 (0 to 100%)

Standard setting : 30 (3%)

This data is used to set the detecting range of speed detecting signal (SDTA).

When the motor speed reaches (setting data/10)% or less of maximum speed, the bit of speed arrival signal (SDTA) is set to ”1”.

0	15	15*i*	16*i*/16	
6163 6343	3343 3563	3199	4199	Speed zero detecting level

Data unit : 0.01%

Data range : 0 to 10000 (0 to 100%)

Standard setting : 75 (0.75%)

This data is used to set the detecting range of speed zero signal (SSTA).

When the motor speed reaches (setting data/100)% or less of maximum speed, the bit of speed zero signal (SSTA) is set to ”1”.

0	15	15*i*	16*i*/16	
6164 6344	3344 3564	3200	4200	Setting of torque limit value

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 50 (50%)

This data is used to set the torque limit value for maximum output torque when the torque limit command HIGH (TLMHA) or torque limit command LOW (TLMLA) is commanded.

Data represents limiting values when the maximum torque is assumed to be 100%.

Torque limit command LOW (TLMLA)	Torque limit command HIGH (TLMHA)	Details
0	0	No torque limitation exists.
0	1	Limited to the setting value of this parameter.
1	0	Limited to approximately half as compared with this parameter.
1	1	

0	15	15*i*	16*i*/16	
6165 6345	3345 3565	3201	4201	Load detecting level 1

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 83 (83%)

This data is used to set the detecting range of load detecting signal 1 (LDT1A).
When the motor power reaches the setting data % or more of maximum power, the bit of load detecting signal 1 (LDT1A) is set to ”1”.

0	15	15*i*	16*i*/16	
6166 6346	3346 3566	3202	4202	Power limit pattern setting

Data unit :

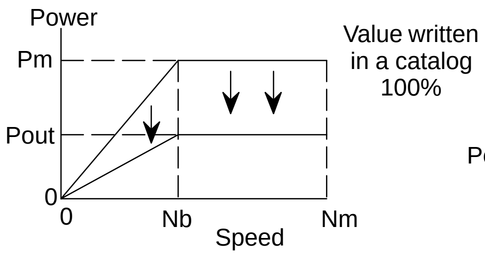
Data range : 0 to 6

Standard setting : 0

Select a proper pattern from the following.
A : When the acceleration/deceleration are slowly performed by limiting the power on acceleration/deceleration only and operation is performed at rated power in normal rotation: (Setting data: 1 or 4) (The function is similar to the soft start/stop.)
B : When the acceleration/deceleration are performed at the maximum power and the power is limited in normal rotation: (Setting data: 2 or 5)
C : When a machine with different power specifications is produced using the same motor and amplifier: (Setting data: 3 or 6)

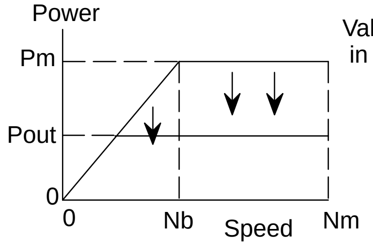
Details	Setting data	
	Pattern 1	**Pattern 2**
Power is not limited.	0	0
A. Power is limited on acceleration/deceleration only.	1	4
B. Power is not limited on acceleration/ deceleration and it is limited on normal rotation.	2	5
C. Power is limited over all operations.	3	6

[Power limit pattern 1] Setting data = 1, 2, 3



$$\text{Pout} = \frac{\text{Setting value of parameter (No. 4203)}}{100} \times \text{Pm}$$

[Power limit pattern 2]   Setting data = 4, 5, 6



$$\text{Pout} = \frac{\text{Setting value of parameter (No. 4203)}}{100} \times \text{Pm}$$

0	15	15*i*	16*i*/16	
6167 6347	3347 3567	3203	4203	Power limit value

Data unit : 1%

Data range : 0 to 100 (0 to 100%)

Standard setting : 100

This data is used to set the value limited when the maximum power (allowable overload capacity) is 100%.
This setting value is valid when power is limited by setting the data on parameter No.4202.

Power limit value = Maximum power × (Setting data)%

0	15	15*i*	16*i*/16	
6168 6348	3348 3568	3204	4204	Position coder method orientation stop position

Data unit : 1 pulse (360_/4096)

Data range : 0 to 4095

Standard setting : 0

This data is used to set the stop position of position coder method spindle orientation.
It can be set at every 360 degrees/4096.
When stop position external command type spindle orientation is set, this parameter becomes invalid.

0	15	15*i*	16*i*/16	
6169 6349	3249 3569	3205	4205	Spindle orientation speed

Data unit : 1 min^{-1} (10 min^{-1} when bit 2 (SPDUNT) of parameter No. 4182 is set to 1)

Data range : 0 to 32767

Standard setting : 0

This parameter sets the orientation speed at the end of the spindle.

When the function for spindle orientation with a reference switch is to be used, set this parameter.

When 0 is set for this parameter, the orientation speed is determined by parameters such as parameter No. 4227.

0	15	15*i*	16*i*/16	
6170 6350	3350 3570	3206	4206	Velocity loop proportional gain on normal operation (HIGH gear) CTH1A = 0
6171 6351	3351 3571	3207	4207	Velocity loop proportional gain on normal operation (LOW gear) CTH1A = 1

Data unit :
Data range : 0 to 32767
Standard setting : 10

This data is used to set the velocity loop proportional gain on normal operation.
When the clutch/gear signal (CTH1A) in the spindle control signals sent form the PMC to NC is set to ”0” and ”1”, the parameters of HIGH and LOW gears are selected, respectively.

0	15	15*i*	16*i*/16	
6172 6352	3352 3572	3208	4208	Velocity loop proportional gain on orientation (HIGH gear) CTH1A = 0
6173 6353	3353 3573	3209	4209	Velocity loop proportional gain on orientation (LOW gear) CTH1A = 1

Data unit :
Data range : 0 to 32767
Standard setting : 10

This data is used to set the velocity loop proportional gain on spindle orientation.

0	15	15*i*	16*i*/16	
6174 6354	3354 3574	3210	4210	Velocity loop proportional gain on servo mode (HIGH gear) CTH1A = 0
6175 6355	3355 3575	3211	4211	Velocity loop proportional gain on servo mode (LOW gear) CTH1A = 1

Data unit :
Data range : 0 to 32767
Standard setting : 10

This sets velocity loop proportional gain in servo mode (rigid tap/spindle positioning etc.).

0	15	15*i*	16*i*/16	
6176 6356	3356 3576	3212	4212	Velocity loop integral gain on normal operation

Data unit :
Data range : 0 to 32767
Standard setting : 10

This data is used to set the velocity loop integral gain on normal operation.

0	15	15*i*	16*i*/16	
6177 6357	3357 3577	3213	4213	Velocity loop integral gain on orientation

Data unit :
Data range : 0 to 32767
Standard setting : 10
This data is used to set the velocity loop integral gain on spindle orientation.

0	15	15*i*	16*i*/16	
6178 6358	3358 3578	3214	4214	Velocity loop integral gain on servo mode

Data unit :
Data range : 0 to 32767
Standard setting : 10
This sets velocity loop integral gain in servo mode (rigid tap/spindle positioning etc.).

0	15	15*i*	16*i*/16		
6180 6360	3360 3580	3216	4216	Gear ratio (HIGH)	CTH1A = 0
6181 6361	3361 3581	3217	4217	Gear ratio (LOW)	CTH1A = 1

Data unit : Motor rotation for one rotation of spindle × 100 (or 1000)
(When parameter No. 4182 #1 (GRUNIT) = 1, motor rotation × 1000)
Data range : 0 to 32767
Standard setting : 100 (Gear ratio=1:1)
These data are used to set the gear ratio between spindle and spindle motor.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1A) in the spindle control signals sent from the PMC to NC.
(Example) When the spindle rotates once, set ”250” as the data when the motor rotates 2.5 times.

0	15	15*i*	16*i*/16		
6182 6362	3362 3582	3218	4218	Position gain on orientation (HIGH)	CTH1A =0
6183 6363	3363 3583	3219	4219	Position gain on orientation (LOW)	CTH1A =1

Data unit : 0.01 sec^{-1}
Data range : 0 to 32767
Standard setting : 1000
These data are used to set the position gain on spindle orientation.

0	15	15*i*	16*i*/16	
6184 6364	3364 3584	3220	4220	Modification rate of position gain on orientation completion

Data unit : 1%
Data range : 0 to 1000
Standard setting : 100 (100%)
This data is used to set the modification rate of position gain on spindle orientation completion.

0	15	15*i*	16*i*/16		
6185 6365	3365 3585	3221	4221	Position gain on servo mode (HIGH)	CTH1A =0
6186 6366	3366 3586	3222	4222	Position gain on servo mode (LOW)	CTH1A =1

Data unit : 0.01 sec^{-1}
Data range : 0 to 32767
Standard setting : 1000
This sets position gain in servo mode (rigid tap/spindle positioning etc.)

0	15	15*i*	16*i*/16	
6187 6367	3367 3587	3223	4223	Grid shift amount in servo mode

Data unit : 1 pulse (360_/4096)
Data range : 0 to 4095
Standard setting : 0
Set this parameter when shifting reference point in servo mode (rigid tap/spindle positioning etc.).
In + data, spindle reference point shifts for set pulse in CCW direction.

0	15	15*i*	16*i*/16	
6190 6370	3370 3590	3226	4226	Orientation completion signal detection level

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.1 degree unit
Data range : 0 to 100
Standard setting : 10
This data is used to set the detecting level of orientation completion signal (ORARA).
When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORARA) in the spindle control signals is set to ”1”.

0	15	15*i*	16*i*/16	
6191 6371	3371 3591	3227	4227	Motor speed limit value on orientation

Data unit : 1%

Data range : 0 to 100

Standard setting : 33

This data is used to set the motor speed limit value on orientation.

Speed limit value = Orientation speed of motor × (Setting data)/100 min^{-1}

Orientation speed of motor = Position gain × Gear ratio × 60 min^{-1}

0	15	15*i*	16*i*/16	
6192 6372	3372 3592	3228	4228	Orientation stop position shift value

Data unit : Position coder method → ±1 pulse unit
Magnetic sensor method → ±0.01 degree unit

Data range : Position coder method → – 4095 to 4095
Magnetic sensor method → –100 to 100

Standard setting : 0

In the position coder method orientation, set this data to shift stop position.
Spindle is shift No. of setting pulse in CCW direction, and stops by data (+).
This data is used to set the position shift amount from the position where the magnetic sensor faces the magnetizing element on magnetic sensor method orientation stop.
The spindle is shifted in CCW direction by data (+).

0	15	15*i*	16*i*/16	
6193 6373	3373 3593	3229	4229	MS signal constant = (L/2)/(2 × π × H) × 4096

L: Length of magnetizing element (mm)

H: Distance from spindle center to magnetizing element (mm)

Data unit :

Data range : 80 to 1000

Standard setting : 200

In the magnetic sensor method orientation, substitute the followings into the expression above to set the MS signal constant.

L: Length of magnetizing element (mm)

H: Distance from spindle center to magnetizing element (mm)

0	15	15*i*	16*i*/16	
6194 6374	3374 3594	3230	4230	MS signal gain adjustment

Data unit :
Data range : –128 to +127
Standard setting : 0

Use this parameter when adjusting the amplitude of the MS signal in the magnetic sensor method orientation.

0	15	15*i*	16*i*/16	
6195 6375	3375 3595	3231	4231	Limitation of regenerative power

Data unit : 1%
Data range : 0 to 1000
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16	
6196 6376	3376 3596	3232	4232	Delay time until the motor power is cut off

Data unit : 10 ms
Data range : 0 to 1000
Standard setting : 20 (200 ms)

The motor power is cut off after stopping the motor (zero speed detection signal SSTA = 1 is detected).
However, when the power is cut off immediately after detecting the zero speed signal, the motor may be operated at low speed due to force of habit.
Detect the zero speed signal and then set the time until the motor power is cut off by this parameter.

0	15	15*i*	16*i*/16	
6197 6377	3377 3597	3233	4233	Time setting during acceleration/deceleration

Data unit : 1 sec
Data range : 0 to 255
Standard setting : 10 (10 sec)

When the deviation between the velocity command and motor speed exceeds the setting level, an velocity error excess alarm (AL-02) occurs.
However, if the velocity command is changed during acceleration/deceleration, the motor speed cannot follow it. Thus, a velocity error excess alarm (AL-02) occurs.
In this case, set the acceleration/deceleration time for preventing velocity error excess alarm from occurring even if there is a speed error during the time set by this parameter. When the lathe load inertia is large, the acceleration/deceleration time becomes longer. Thus, set the value accordingly.

0	15	15*i*	16*i*/16	
6198 6378	3378 3598	3234	4234	Spindle load monitor observer gain 1 (SUB side)

(9D00. D)

Data unit :
Data range : 0 to 32767
Standard setting : 500

0	15	15*i*	16*i*/16	
6199 6379	3379 3599	3235	4235	Spindle load monitor observer gain 2 (SUB side)

(9D00. D)

Data unit :
Data range : 0 to 32767
Standard setting : 500

0	15	15*i*	16*i*/16	
6200 6380	3380 3600	3236	4236	Motor voltage setting on normal rotation
6201 6381	3381 3601	3237	4237	Motor voltage setting on orientation
6202 6382	3382 3602	3238	4238	Motor voltage setting on servo mode

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor mode.

When executing rigid tapping, Motor voltage setting on servo mode is set to ”100” normally.

0	15	15*i*	16*i*/16	
6203 6383	3383 3603	3239	4239	The reduction rate of position loop gain in returning to the reference point on servo mode

Data unit : 1%
Data range : 0 to 100
Standard setting : 100 (100%)

This sets the reduction rate of position gain in returning to the reference point in servo mode (rigid tap/spindle positioning etc.).

0	15	15*i*	16*i*/16	
6204 6384	3384 3604	3240	4240	Feedforward coefficient

Data unit : 1%
Data range : 0 to 100 (0 to 100%)
Standard setting : 0

Set the feedforward coefficient when feedforward control is executed in servo mode (rigid tap, spindle positioning).

0	15	15*i*	16*i*/16	
6205 6385	3385 3605	3241	4241	Velocity loop feedforward coefficient

Data unit :

Data range : 0 to 32767

Standard setting : 0

Set the velocity loop feed forward coefficient when feed forward control is executed in servo mode (rigid tap, spindle positioning).

0	15	15*i*	16*i*/16		
6207 6387	3387 3607	3243	4243	Number of spindle gear teeth (HIGH)	CTH1A = 0
6208 6388	3388 3608	3244	4244	Number of position detector gear teeth (HIGH)	CTH1A = 0
6209 6389	3389 3609	3245	4245	Number of spindle gear teeth (LOW)	CTH1A = 1
6210 6390	3390 3610	3246	4246	Number of position detector gear teeth (LOW)	CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 0

These parameters set an arbitrary gear ratio between the spindle and position detector (position coder). These parameters are used when the function for spindle orientation with an external one–rotation signal switch is used (when bit 3 (PCGEAR) of parameter No. 4185 is 1).

When bit 3 (PCGEAR) of parameter No. 4185 is 0, 1 is assumed even if 0 is set for these parameters.

0	15	15*i*	16*i*/16	
6211 6391	3391 3611	3247	4247	Time constant for spindle load monitor magnetic flux compensation (MAIN side for high–speed range)

(9D00. D)

Data unit : 1 msec

Data range : 0 to 8192

Standard setting : 500

0	15	15*i*	16*i*/16	
6212 6392	3392 3612	3248	4248	Spindle load monitor torque constant (MAIN side for high–speed range)

(9D00. D)

Data unit :

Data range : 0 to 32767

Standard setting : Varies with the motor model.

0	15	15*i*	16*i*/16	
6213 6393	3393 3613	3249	4249	Spindle load monitor observer gain 1 (MAIN side)

(9D00. D)

Data unit :
Data range : 0 to 32767
Standard setting : 500

0	15	15*i*	16*i*/16	
6214 6394	3394 3614	3250	4250	Spindle load monitor observer gain 2 (MAIN side)

(9D00. D)

Data unit :
Data range : 0 to 32767
Standard setting : 500

0	15	15*i*	16*i*/16	
6215 6395	3395 3615	3251	4251	Time constant for spindle load monitor magnetic flux compensation (MAIN side for low–speed range) (9D00. D)
6216 6396	3396 3616	3252	4252	Time constant for spindle load monitor magnetic flux compensation (SUB side for high–speed range) (9D00. D)
6217 6397	3397 3617	3253	4253	Time constant for spindle load monitor magnetic flux compensation (SUB side for low–speed range) (9D00. D)

Data unit : 1 msec
Data range : 0 to 8192
Standard setting : 500

0	15	15*i*	16*i*/16	
6220 6400	3400 3620	3256	4256	Base speed of motor power specifications

0	15	15*i*	16*i*/16	
6221 6401	3401 3621	3257	4257	Limit value for motor power specifications

0	15	15*i*	16*i*/16	
6222 6402	3402 3622	3258	4258	Base speed

0	15	15*i*	16*i*/16	
6223 6403	3403 3623	3259	4259	Magnetic flux down start speed

0	15	15*i*	16*i*/16	
6224 6404	3404 3624	3260	4260	Current loop proportional gain data

0	15	15*i*	16*i*/16	
6225 6405	3405 3625	3261	4261	Current loop integral gain data

0	15	15*i*	16*i*/16	
6226 6406	3406 3626	3262	4262	Current loop integral gain zero point

0	15	15*i*	16*i*/16	
6227 6407	3407 3627	3263	4263	Current loop proportional gain speed coefficient

0	15	15*i*	16*i*/16	
6228 6408	3408 3628	3264	4264	Current conversion constant

0	15	15*i*	16*i*/16	
6229 6409	3409 3629	3265	4265	Secondary current coefficient for excitation current

0	15	15*i*	16*i*/16	
6230 6410	3410 3630	3266	4266	Current prediction constant

0	15	15*i*	16*i*/16	
6231 6411	3411 3631	3267	4267	Slip constant

0	15	15*i*	16*i*/16	
6232 6412	3412 3632	3268	4268	Slip compensation constant of high-speed rotation

0	15	15*i*	16*i*/16	
6233 6413	3413 3633	3269	4269	Motor applied voltage compensation constant by dead time

0	15	15*i*	16*i*/16	
6234 6414	3414 3634	3270	4270	Electromotive voltage compensation coefficient

0	15	15*i*	16*i*/16	
6235 6415	3415 3635	3271	4271	Electromotive voltage phase compensation coefficient

0	15	15*i*	16*i*/16	
6236 6416	3416 3636	3272	4272	Electromotive voltage compensation speed coefficient

0	15	15*i*	16*i*/16	
6237 6417	3417 3637	3273	4273	Time constant of torque change

Data unit : 1 ms
Data range : 0 to 1000
Standard setting : 5

0	15	15*i*	16*i*/16	
6238 6418	3418 3638	3274	4274	Load meter display value on maximum output

0	15	15*i*	16*i*/16	
6239 6419	3419 3639	3275	4275	Maximum power limit zero point

0	15	15*i*	16*i*/16	
6240 6420	3420 3640	3276	4276	Secondary electrical current coefficient on rigid tap

0	15	15*i*	16*i*/16	
6241 6421	3421 3641	3277	4277	Electromotive voltage phase compensation constant on deceleration

0	15	15*i*	16*i*/16	
6242 6422	3422 3642	3278	4278	Speed detection filter time constant

Data unit : 0.1 ms
Data range : 0 to 10000
Standard setting : 0

0	15	15*i*	16*i*/16	
6244 6424	3424 3644	3280	4280	Time constant for voltage filter used for electromotive force compensation

0	15	15*i*	16*i*/16	
6245 6425	3425 3645	3281	4281	Spindle load monitor torque constant (MAIN side for low–speed range) (9D00. D)
6246 6426	3426 3646	3282	4282	Spindle load monitor torque constant (SUB side for high–speed range) (9D00. D)
6247 6427	3427 3647	3283	4283	Spindle load monitor torque constant (SUB side for low–speed range) (9D00. D)

Data unit :
Data range : 0 to 32767
Standard setting : Varies with the motor model.

3.4 LOW SPEED RANGE PARAMETERS FOR SUB SPINDLE BOTH WITH SPEED RANGE SWITCHING CONTROL AND WITH SPINDLE SWITCHING CONTROL

0	15	15*i*	16*i*/16	
6248 6428	3428 3648	3284	4284	Motor voltage setting on normal rotation
6249 6429	3429 3649	3285	4285	Moror voltage setting on servo mode

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16	
6250 6430	3430 3650	3286	4286	Base speed of motor power specifications

0	15	15*i*	16*i*/16	
6251 6431	3431 3651	3287	4287	Limit value for motor power specifications

0	15	15*i*	16*i*/16	
6252 6432	3432 3652	3288	4288	Base speed

0	15	15*i*	16*i*/16	
6253 6433	3433 3653	3289	4289	Magnetic flux down start speed

0	15	15*i*	16*i*/16	
6254 6434	3434 3654	3289	4290	Current loop proportional gain data

0	15	15*i*	16*i*/16	
6255 6435	3435 3655	3291	4291	Current loop integral gain data

0	15	15*i*	16*i*/16	
6256 6436	3436 3656	3292	4292	Current loop integral gain zero point

0	15	15*i*	16*i*/16	
6257 6437	3437 3657	3293	4293	Current loop proportional gain speed coefficient

0	15	15*i*	16*i*/16	
6258 6438	3438 3658	3294	4294	Current conversion constant

0	15	15*i*	16*i*/16	
6259 6439	3439 3659	3295	4295	Secondary current coefficient for excitation current

0	15	15*i*	16*i*/16	
6260 6440	3440 3660	3296	4296	Current prediction constant

0	15	15*i*	16*i*/16	
6261 6441	3441 3661	3297	4297	Slip constant

0	15	15*i*	16*i*/16	
6262 6442	3442 3662	3298	4298	Slip compensation constant of high-speed rotation

0	15	15*i*	16*i*/16	
6263 6443	3443 3663	3299	4299	Motor applied voltage compensation constant by dead time

0	15	15*i*	16*i*/16	
6264 6444	3444 3664	3300	4300	Electromotive voltage compensation coefficient

0	15	15*i*	16*i*/16	
6265 6445	3445 3665	3301	4301	Electromotive voltage phase compensation coefficient

0	15	15*i*	16*i*/16	
6266 6446	3446 3666	3302	4302	Electromotive voltage compensation speed coefficient

0	15	15*i*	16*i*/16	
6267 6447	3447 3667	3303	4303	Time constant of torque change

Data unit : 1 ms
Data range : 0 to 1000
Standard setting : 5

0	15	15*i*	16*i*/16	
6268 6448	3448 3668	3304	4304	Maximum power limit zero point

0	15	15*i*	16*i*/16	
6269 6449	3449 3669	3305	4305	Secondary electrical current coefficient on rigid tap

0	15	15*i*	16*i*/16	
6270 6450	3450 3670	3306	4306	Electromotive voltage phase compensation constant on deceleration

0	15	15*i*	16*i*/16	
6271 6451	3451 3671	3307	4307	Regenerative power limit

0	15	15*i*	16*i*/16	
6272 6452	3452 3672	3308	4308	Time constant for voltage filter used for electromotive force compensation

0	15	15*i*	16*i*/16	
6273 6453	3453 3673	3309	4309	Motor model code

Data unit :
Data range :
Standard setting : Depends on the motor model.

Set the model code when setting the first parameter of the spindle motor.
At this time it is necessary to set the following parameters simultaneously.

Series 0 : Parameter (PRLOAD No.6159#7)=1
Series 15*i*/15 : Parameter (PRLOAD No.5607#0)=0
Series 16*i*/16 : Parameter (PRLOAD No.4195#0)=1

0	15	15*i*	16*i*/16	
6276 6456	3456 3676	3312	4312	Detection level for the approach signal for position coder method orientation (MAIN side)

Data unit : ±1 pulse

Data range : 0 to 32767

Standard setting : 0

Set a detection level for approach signal (PORAR2) for position coder method orientation.
When the position of the spindle is within the set data range, orientation approach signal (PORAR2) is set to 1.

0	15	15*i*	16*i*/16	
6277 6457	3457 3677	3313	4313	Detection level 1 for the completion signal for orientation by a magnetic sensor (MAIN side)

Data unit : ±0.1 degree

Data range : 0 to 100

Standard setting : 0

Set a detection level for completion signal 1 (MORAR1) for orientation by a magnetic sensor.
When the position of the spindle is within the set data range, orientation completion signal 1 (MORAR1) is set to 1.

0	15	15*i*	16*i*/16	
6278 6458	3458 3678	3314	4314	Detection level 2 for the completion signal for orientation by a magnetic sensor (MAIN side)

Data unit : ±0.1 degree

Data range : 0 to 100

Standard setting : 0

Set a detection level for completion signal 2 (MORAR2) for orientation by a magnetic sensor.
When the position of the spindle is within the set data range, orientation completion signal 2 (MORAR2) is set to 1.

0	15	15*i*	16*i*/16	
6279 6459	3459 3679	3315	4315	Stop position shift amount for orientation by a magnetic sensor (MAIN side)

Data unit : ±0.01 degree

Data range : –100 to +100

Standard setting : 0

This parameter is used to shift the stop position of the spindle for orientation by a magnetic sensor.
Setting a positive (+) value causes the spindle to be shifted counterclockwise.

0	15	15*i*	16*i*/16	
6280 6460	3460 3680	3316	4316	Detection level for the approach signal for position coder method orientation (SUB side)

Data unit : ±1 pulse

Data range : 0 to 32767

Standard setting : 0

Set a detection level for approach signal (PORAR2) for position coder method orientation.
When the position of the spindle is within the set data range, orientation approach signal (PORAR2) is set to 1.

0	15	15*i*	16*i*/16	
6281 6461	3461 3681	3317	4317	Detection level 1 for the completion signal for orientation by a magnetic sensor (SUB side)

Data unit : ±0.1 degree

Data range : 0 to 100

Standard setting : 0

Set a detection level for completion signal 1 (MORAR1) for orientation by a magnetic sensor.
When the position of the spindle is within the set data range, orientation completion signal 1 (MORAR1) is set to 1.

0	15	15*i*	16*i*/16	
6282 6462	3462 3682	3318	4318	Detection level 2 for the completion signal for orientation by a magnetic sensor (SUB side)

Data unit : ±0.1 degree

Data range : 0 to 100

Standard setting : 0

Set a detection level for completion signal 2 (MORAR2) for orientation by a magnetic sensor.
When the position of the spindle is within the set data range, orientation completion signal 2 (MORAR2) is set to 1.

0	15	15*i*	16*i*/16	
6283 6463	3463 3683	3319	4319	Stop position shift amount for orientation by a magnetic sensor (SUB side)

Data unit : ±0.01 degree

Data range : –100 to +100

Standard setting : 0

This parameter is used to shift the stop position of the spindle for orientation by a magnetic sensor.
Setting a positive (+) value causes the spindle to be shifted counterclockwise.

0	15	15*i*	16*i*/16	
6284 6464	3464 3684	3320	4320	Spindle orientation deceleration constant (MAIN side, HIGH) CTH1A = 0, CTH2A = 0
6285 6465	3465 3685	3321	4321	Spindle orientation deceleration constant (MAIN side, MEDIUM HIGH) CTH1A = 0, CTH2A = 1
6286 6466	3466 3686	3322	4322	Spindle orientation deceleration constant (MAIN side, MEDIUM LOW) CTH1A = 1, CTH2A = 0
6287 6467	3467 3687	3323	4323	Spindle orientation deceleration constant (MAIN side, LOW) CTH1A = 1, CTH2A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 0

Set a deceleration constant for shortest–time spindle orientation. When 0 is set in these parameters, normal orientation is performed.

0	15	15*i*	16*i*/16	
6288 6468	3468 3688	3324	4324	Spindle orientation deceleration constant (SUB side, HIGH) CTH1A = 0
6289 6469	3469 3689	3325	4325	Spindle orientation deceleration constant (SUB side, LOW) CTH1A = 1

Data unit :

Data range : 0 to 32767

Standard setting : 0

Set a deceleration constant for shortest–time spindle orientation. When 0 is set in these parameters, normal orientation operation is performed.

0	15	15*i*	16*i*/16	
6290 6470	3470 3690	3326	4326	Spindle orientation control mode switching pulse width (MAIN side)
6291 6471	3471 3691	3327	4327	Spindle orientation control mode switching pulse width (SUB side)

Data unit : $\overline{\text{(number of control mode switching pulses)}} \times 64$

Data range : 0 to 32767

Standard setting : 0

Set a pulse width for orientation control mode switching in shortest–time spindle orientation.
When 0 is set in these parameters, the positioning mode based on the position gain is set when the position deviation is 205 pulses (5% of 4096 pulses) or less.

0	15	15*i*	16*i*/16	
6292 6472	3472 3692	3328	4328	Command multiplier for spindle orientation by a position coder (MAIN side)
6293 6473	3473 3693	3329	4329	Command multiplier for spindle orientation by a position coder (SUB side)

Data unit :
Data range : 0 to 32767
Standard setting : 0

Set a command multiplier for the spindle orientation function with an externally set incremental command.
When 0 is set in these parameters, 1 is assumed to have been specified.
To use spindle speed control, set 4096 in these parameters.

0	15	15*i*	16*i*/16	
6294 6474	3474 3694	3330	4330	Motor excitation delay for spindle orientation (MAIN side)
6295 6475	3475 3695	3331	4331	Motor excitation delay for spindle orientation (SUB side)

Data unit : 1 msec
Data range : 0 to 32767
Standard setting : 0

When 0 is set in these parameters, a specification of 50 msec is assumed. The setting of these parameters is valid only when the speed is within the range from the speed zero detection level (SST = 0) to the orientation speed.
If overshoot occurs when the spindle stops during spindle orientation from a speed within the range from the speed zero detection level (SST = 0) to the orientation speed, overshoot can be suppressed by setting a value greater than 50 msec.

0	15	15*i*	16*i*/16	
6298 6478	3478 3698	3334	4334	Arbitrary number of speed detector pulses (MAIN side)
6299 6479	3479 3699	3335	4335	Arbitrary number of speed detector pulses (SUB side)

Data unit : 1 λ/rev (number of speed detector teeth)
Data range : 0, 32 to 1024
Standard setting : 0

Set these parameters when the number of teeth of the speed detector mounted onto the motor is other than 64, 128, 256, 512, 192, or 384.
When 0 is set in these parameters, the settings of bits 2, 1, 0 (VDT3, 2, 1) of parameter No. 4011 and bits 2, 1, 0 (VDT3, 2, 1) of parameter No. 4187 are assumed, respectively.

0	15	15*i*	16*i*/16

Data unit : 1 min^{-1} (10 min^{-1} when bit 2 (SPDUNT) of parameter No. 4006 is set to 1)

6300 6480	3480 3700	3336	4336	Magnetic flux switching point used for calculating an acceleration/ deceleration time constant used for spindle synchronization control

Data range : 0 to 32767

Standard setting : 0

Set a speed for switching the acceleration/deceleration time constant used for spindle synchronization control.
In the area below the speed set in this parameter, acceleration/ deceleration is performed according to the time constant set in parameter No. 4032 (acceleration/deceleration time constant at spindle synchronization control). In the area above the speed set in this parameter, the time constant varies with the torque characteristics.

When 0 is set in this parameter, linear acceleration/deceleration is performed. Set a time constant in parameter No. 4032.

The same value must be specified in this parameter and parameter No. 4032 for the first and second spindles, subject to spindle synchronization.

0	15	15*i*	16*i*/16	
6301 6481	3481 3701	3337	4337	Velocity loop gain speed compensation coefficient (MAIN side)
6302 6482	3482 3702	3338	4338	Velocity loop gain speed compensation coefficient (SUB side)

Data unit : 1%

Data range : 0 to 1000

Standard setting : 0

Set the velocity loop gain at the maximum speed by specifying a percentage of the velocity loop gain at the base speed.
When 0 is set in these parameters, the velocity loop gain is constant.

0	15	15*i*	16*i*/16	
6303 6483	3483 3703	3339	4339	Torque clamp level

(9D00. D)

Data unit : 1%

Data range : 0 to 100

Standard setting : 0

0	15	15*i*	16*i*/16	
6304 6484	3484 3704	3340	4340	Bell–shaped acceleration/deceleration time constant for spindle synchronization

(9D00. D)

Data unit : 1 msec

Data range : 0 to 512

Standard setting : 0

Set this parameter to reduce the synchronization error between the spindles near the start and end points of linear acceleration/deceleration in spindle synchronization.

When 0 is set in this parameter, linear acceleration/deceleration is performed.

The same value must be specified in this parameter for the two spindles subject to spindle synchronization.

0	15	15*i*	16*i*/16	
6305 6485	3485 3705	3341	4341	Unexpected load detection level

(9D00. D)

Data unit : 0.01%

Data range : 0 to 10000

Standard setting : 0

Set a level for detecting the unexpected load signal by specifying a ratio to the maximum motor output torque.
When 0 is set in this parameter, the unexpected load detection signal is not output.

0	15	15*i*	16*i*/16	
6308 6488	3488 3708	3344	4344	Advanced feed–forward coefficient

Data unit : 0.01%

Data range : 0 to 10000

Standard setting : 0

0	15	15*i*	16*i*/16	
6309 6489	3489 3709	3345	4345	Spindle motor speed command detection level

(9D00. D)

Data unit : 1 min^{-1}

Data range : 0 to 32767

Standard setting : 0

Set a level for detecting the speed command detection signal (VCMLVL) output from the spindle amplifier to the CNC.

When 0 is set in this parameter, the speed command detection signal (VCMLVL) is always 0.

0	15	15*i*	16*i*/16	
6310 6490	3490 3710	3346	4346	Incomplete integration coefficient

Data unit :
Data range : 0 to 32767
Standard setting : 0
When 0 is set in this parameter, complete integration is used.

0	15	15*i*	16*i*/16	
6311 6491	3491 3711	3347	4347	Level for detecting a speed difference between spindle 1 and spindle 2 during slave operation

Data unit : 1 min^{-1} (10 min^{-1} when bit 2 (SPDUNT) of parameter No. 4006 is set to 1)
Data range : 0 to 32767
Standard setting : 0
Set a level for detecting the signal (MSOVRS) that indicates the speed difference between spindle 1 and spindle 2 in slave operation.
Set this parameter for the second spindle 2 only.
When 0 is set in this parameter, 100 min^{-1} is assumed.

0	15	15*i*	16*i*/16	
6312 6492	3492 3712	3348	4348	Overload current alarm detection level (for low-speed range)

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16	
6313 6493	3493 3713	3349	4349	Overload current alarm detection time constant

Data unit : 1 second
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16	
6314 6494	3494 3714	3350	4350	Overload current alarm detection level (for high-speed range)

Data unit :
Data range : 0 to 32767
Standard setting : Depends on the motor model.

0	15	15*i*	16*i*/16	
6315 6495	3495 3715	3351	4351	Current detection offset compensation

Data unit :

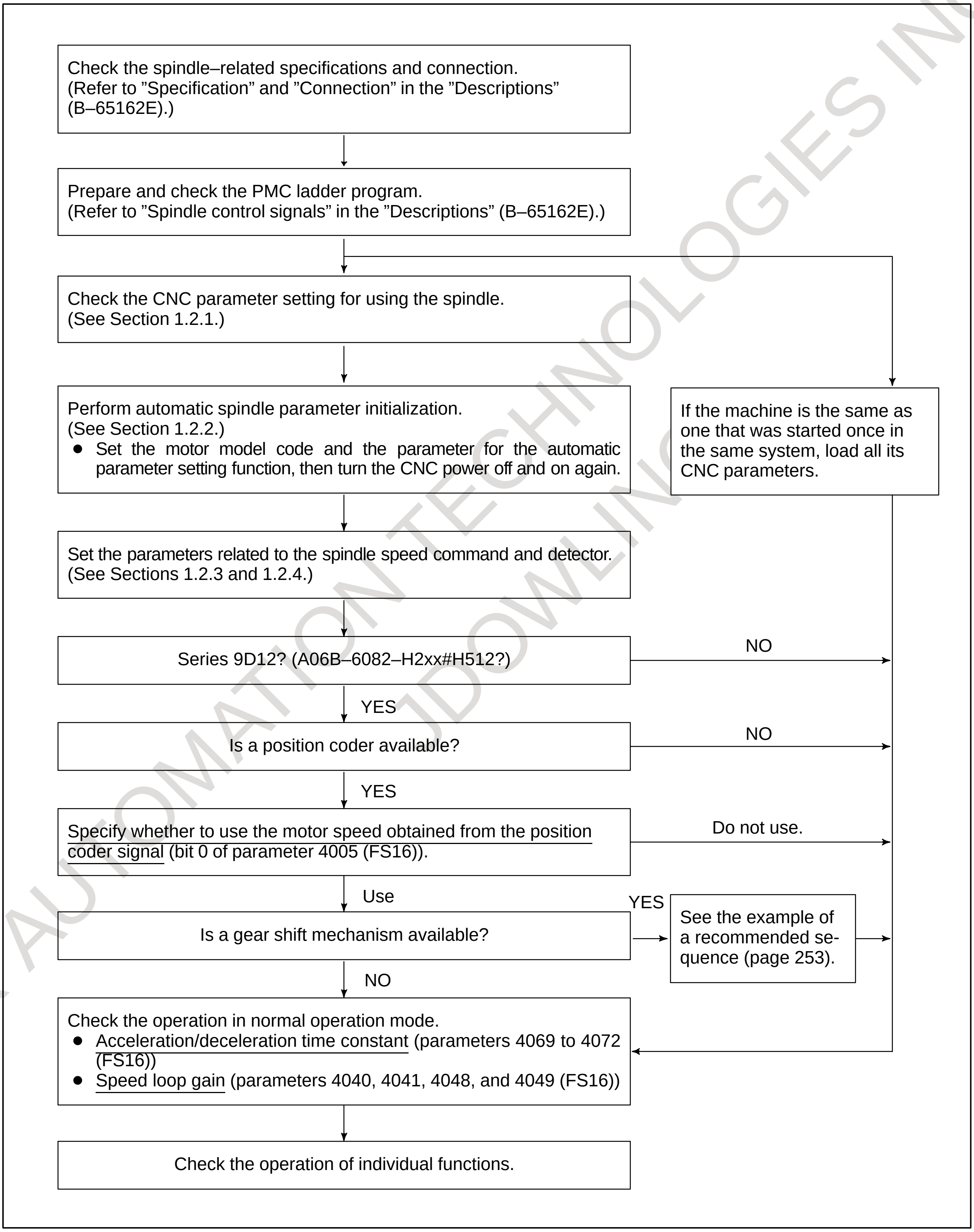
Data range : 0 to ±32767

Standard setting : 0

II. FANUC AC SPINDLE MOTOR αC series

1 ADJUSTMENT

1.1 START–UP PROCEDURE



1.2 PARAMETERS RELATED TO START–UP

1.2.1 Parameters for the Spindle System

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st spindle	2nd spindle	1st spindle	2nd spindle			
– (*1)	– (*1)	5606 #0	5606 #1	5606 #0	– (*1)	Whether to use spindle amplifiers
0071 #4		5604 #0		5841 (*3)	3701 #4	Number of Serial spindle amplifiers connected.(*2)

*1 CNC optional parameter

*2 When the number of the connected Serial spindle amplifiers is two, the α C series spindle amplifier is connected to the 1st spindle and the α C series spindle amplifier is connected to the 2nd spindle.

*3 For the Series 15i, set an axis number in parameter No. 5841.

1.2.2 Automatic Spindle Parameter Initialization

(1) Procedure for automatic spindle parameter initialization

Perform automatic spindle parameter initialization according to the following procedure.

① Set the model code for desired motor for automatic parameter initialization. The model code are listed in appendix C.

Parameter No.						Setting
0		15		15*i*	16*i*/16	
1st spindle	2nd spindle	1st spindle	2nd spindle			
6633	6773	3133	3273	3133	4133	Motor model code

② Set the parameter to enable automatic spindle parameter initialization.

Parameter No.						Setting
0		15		15*i*	16*i*/16	
1st spindle	2nd spindle	1st spindle	2nd spindle			
6519 #7	6659 #7	–	–	–	4019 #7	1
–	–	5607 #0	5607 #1	5607 #0	–	0

> **NOTE**
> This bit parameter is reset to its original value after automatic parameter initialization.

③ Turn off the CNC, and turn on it again. Then, the spindle standard setting parameters are loaded automatically.

1.2.3 Parameters Related to Spindle Speed Command

(1) List of parameters for spindle speed commands

<table>
<tr><th colspan="5">Parameter No.</th><th rowspan="2">Description</th></tr>
<tr><th>0T</th><th>0M</th><th>15</th><th>15i</th><th>16i/16</th></tr>
<tr><td colspan="2">0013
#7, 6</td><td>–</td><td>–</td><td>3706
#7, 6</td><td>Spindle speed command polarity (Enabled when input signal SSIN is set to “0”)</td></tr>
<tr><td>–</td><td>0543
(*1)</td><td>5618</td><td>–</td><td>3735</td><td>Minimum clamp speed of spindle motor</td></tr>
<tr><td>–</td><td>0542
(*1)</td><td>5619</td><td>–</td><td>3736</td><td>Maximum clamp speed of spindle motor</td></tr>
<tr><td colspan="2">6520</td><td>3020</td><td>3020</td><td>4020</td><td>Maximum speed of spindle motor</td></tr>
<tr><td>0539</td><td>0577</td><td>5613</td><td>5613</td><td>–</td><td>Spindle speed command offset (Always set to 0)</td></tr>
<tr><td colspan="2">0516</td><td>5614</td><td>5614</td><td>–</td><td>Spindle speed command gain adjustment (Always set to “1000”)</td></tr>
<tr><td>0540
to
0543</td><td>0541
0539
0555
(*2)</td><td>–
–
–</td><td>–
–
–</td><td>3741
to
3744</td><td>Maximum spindle speed corresponding to the gear</td></tr>
</table>

*1 Supported for M series only. However, these parameters are disabled, when the constant surface speed control option is used.

*2 When the constant surface speed control option is used with M series, the same parameter numbers as for the T series (No.0540 to 0543) are used.

The parameters related to spindle speed commands and the sequence of the spindle speed command are the same as α series.

1.2.4 Parameters Related to Detectors

(1) List of parameters for detectors

Parameter No.					Description
0T	0M	15	15*i*	16*i*/16	
6500 #0		3000 #0	3000 #0	4000 #0	Direction of spindle and motor rotation (*1)
6501 #2		3001 #2	3001 #2	4001 #2	Whether to use the position coder signal
6500 #2		3000 #2	3000 #2	4000 #2	Position coder mounting direction (*2)
0003 #7, 6	0028 #7, 6	5610	–	3706 #1, 0	Gear ratio between spindle and position coder (Always set to "×1")
6556 to 6559		3056 to 3059	3056 to 3059	4056 to 4059	Spindle to motor gear ratio data (This data is selected by spindle control DI signals CTH1A and CTH2A.) (*1)(*2)

*1 Spindle to motor gear ratio data is used to calculate the motor speed data from the position coder signal, so, please set these data exactly.

*2 When these parameters are not set correctly, there is a case that AL–02, 31, 35 occurrs. (9D11/G or later, 9D12/A or later)

(2) Detail of parameter for detector

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st :	6500	3000	3000	4000						POSC1		ROTA1
2nt:	6640	3140										

ROTA1: The relationship of the rotation direction between spindle and spindle motor

0: Rotates the spindle and spindle motor in the same direction.

1: Rotates the spindle and spindle motor in the reverse direction.

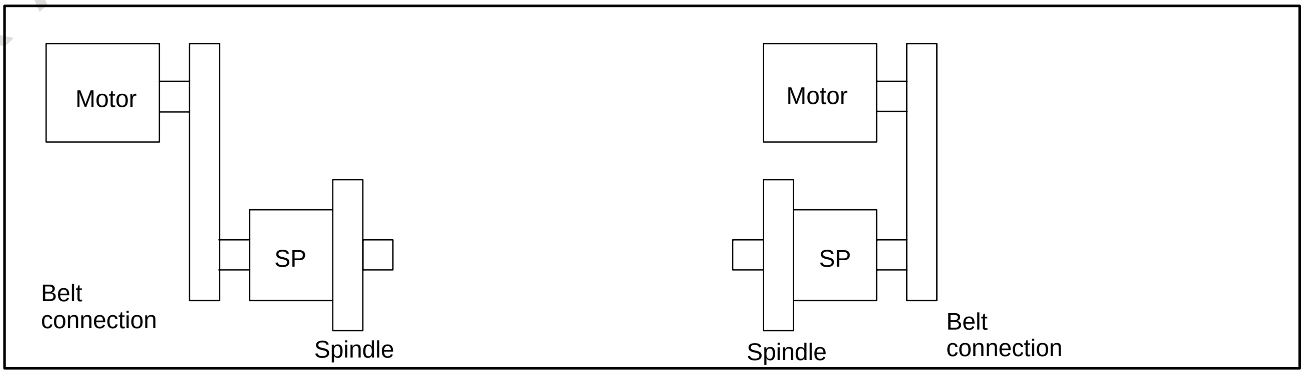
When the spindle and motor are connected directly, set this bit to "0".(same direction)

Example

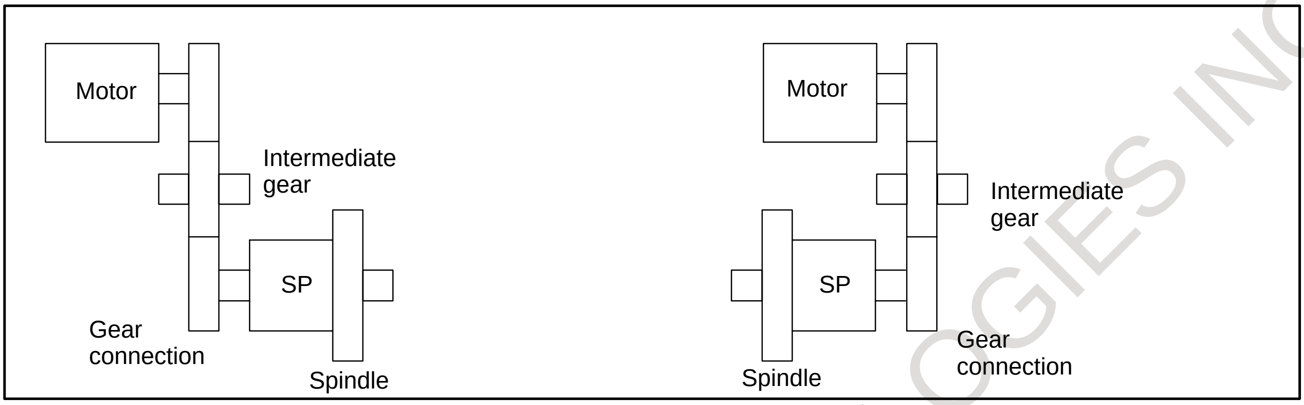
Examples of rotation direction of spindle and motor

(a) When the spindle is coupled directly to the motor, specify "same direction."

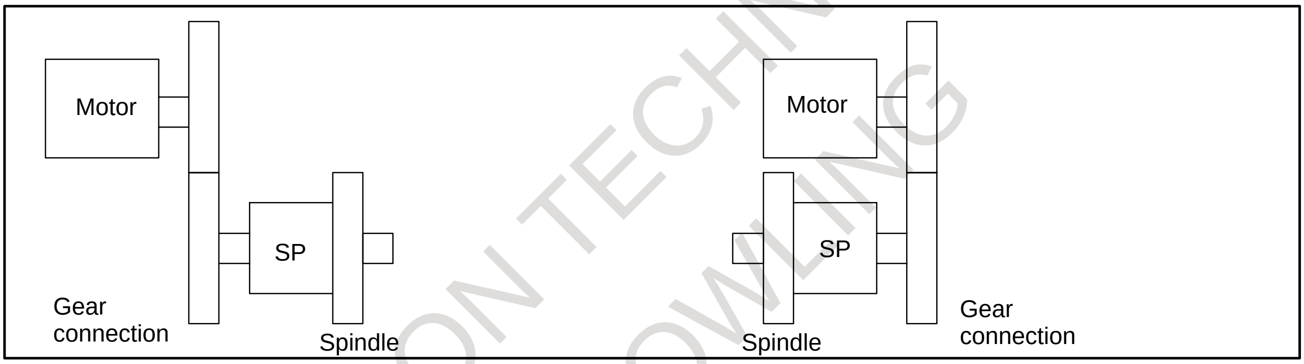
(b) When the spindle and motor are connected by the belt, the spindle and motor rotate in the same direction.



(c) When the spindle and motor are connected by the gear (with intermediate shaft), the spindle and motor rotace in the same direction.



(d) When the spindle and motor are connected by the gear (with no intermediate shaft), the spindle and motor rotate in the reverse direction.



POSC1: The mounting direction of position coder

0: Rotates the spindle and position coder in the same direction

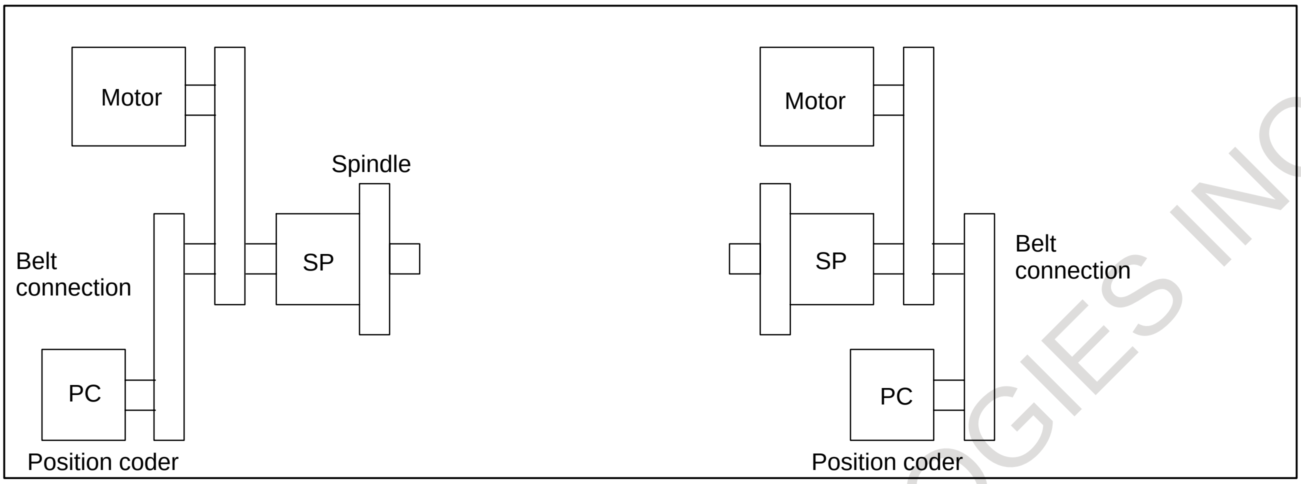
1: Rotates the spindle and position coder in the reverse direction

When the spindle and position coder are connected directly, set the bit to "0". (same direction)

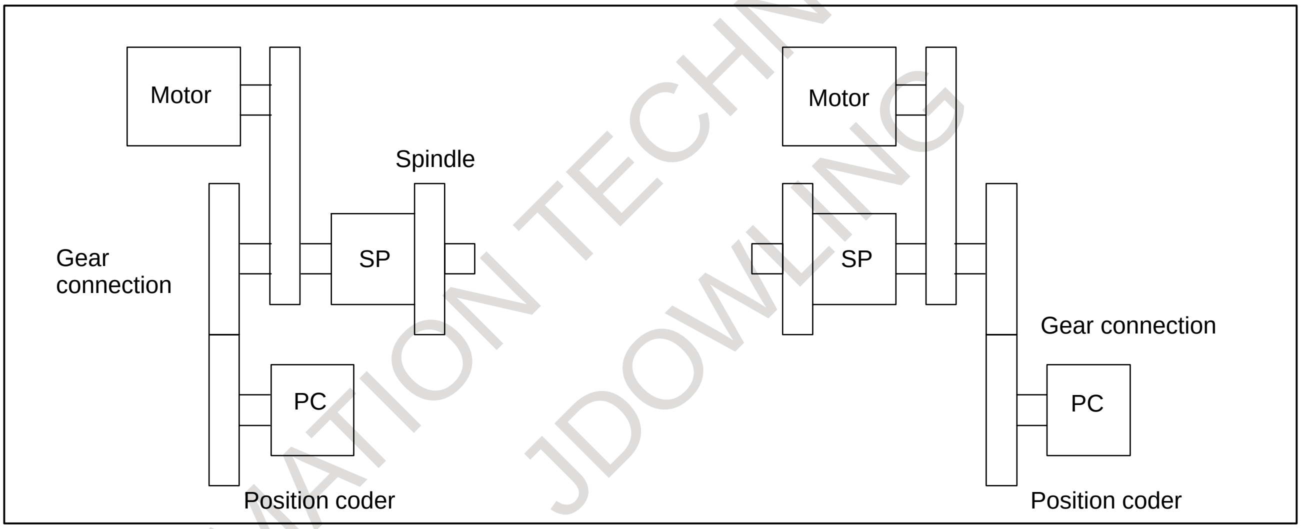
Example

Examples of rotation direction of spindle and position coder:

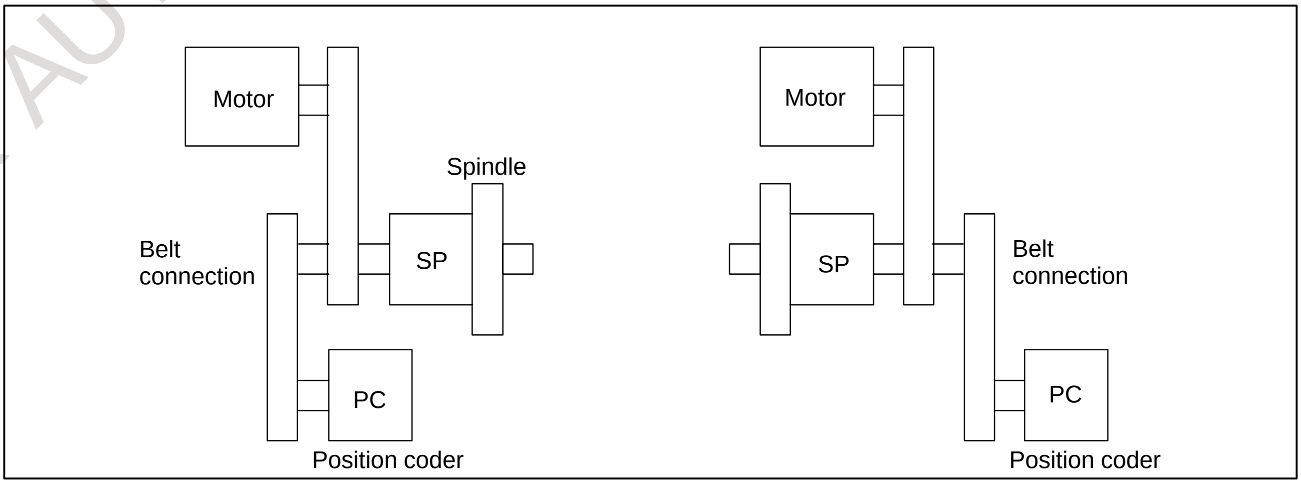
(a) When the spindle and position coder are connected by the belt as shown below, the spindle and position coder rotate in the same direction.



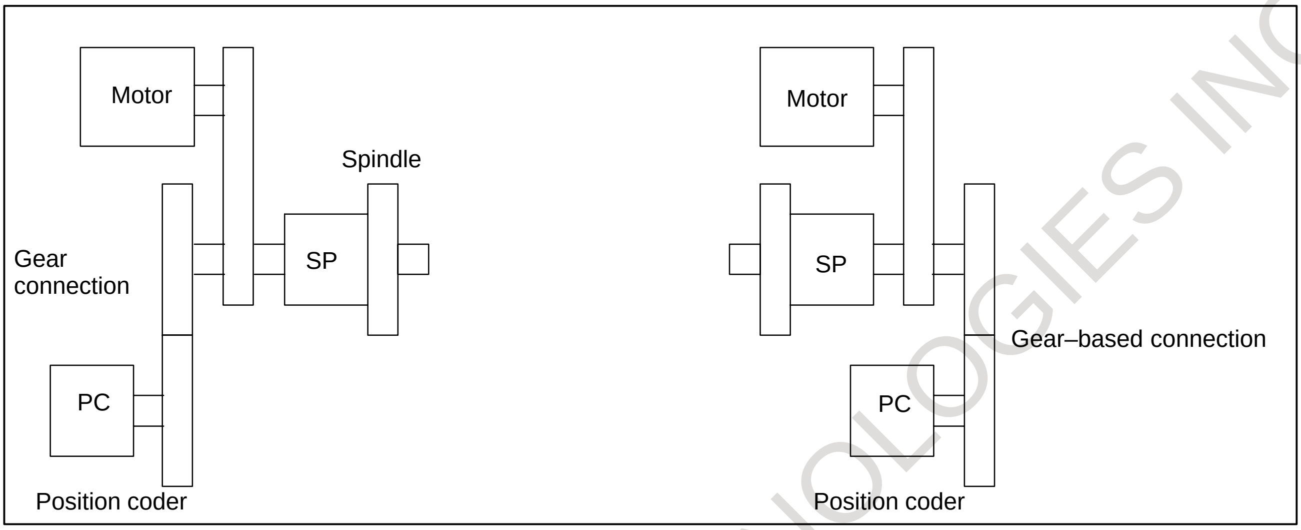
(b) When the spindle and position coder are connected by the gear as shown below, the spindle and position coder rotate in the same direction.



(c) When the spindle and position coder are connected by the belt as shown below, the spindle and position coder rotate in the reverse direction.



(d) When the spindle and position coder are connected by the gear as shown below, the spindle and position coder rotate in the reverse direction.



	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st :	6501	3001	3001	4001						POSC2		
2nt:	6641	3141										

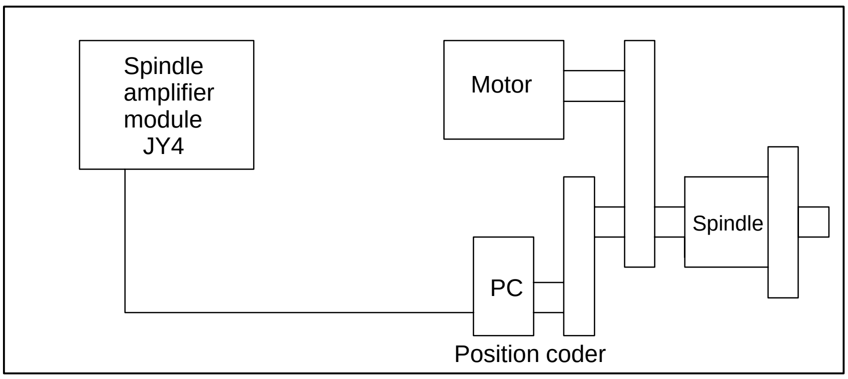
POSC2: Position coder signal is used or not.

0 : Not used.

1 : Used.

Set this bit to ”1” when using the following functions:

- Position coder method spindle orientation
- Spindle synchronization control (9D12 series only)
- Rigid tapping (9D12 series only)
- Feed per revolution
  (Thread cutting, Constant surface speed control)
- When displaying number of spindle rotation (SACT display)
- Using the motor speed data calculated from position coder signal to control the velocity (9D12 series only)



0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0

PCLS: Determines the position coder signal disconnection (AL–27) detection.

0: Performs disconnection detection (Normally set to “0”)

1st :	6507	3007	3007	4007		PCALCH	PCLS				
2nt:	6647	3147									

1: Not performs disconnection detection

Set this bit to "1" temporarily when adjusting position feedback signal. After adjustment, reset it to "0".

PCALCH:

Enables or disables detection of the alarm (AL–41, AL–42, AL–47) related to the position coder signals.

0: Detects the alarms related to the position coder signal. (Normally set to "0")

1: Does not detect the alarms related to the position coder signal.

(3) Setting the detector–related parameter

¿¿ In case of using the position coder

<u>Example of a recommended sequence for shifting gears for a spindle with a gear shift mechanism</u>

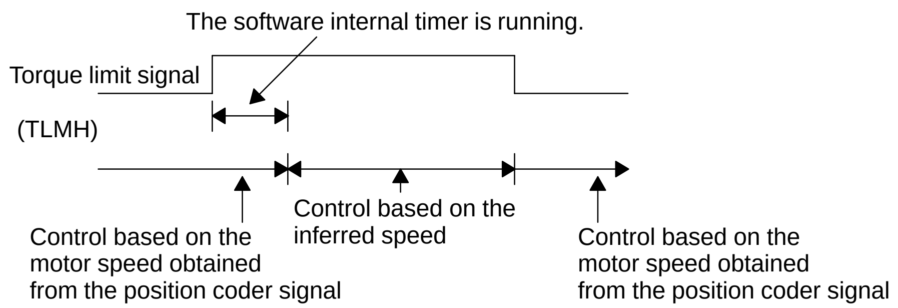
(For the Series 9D12 only)

(Conditions)

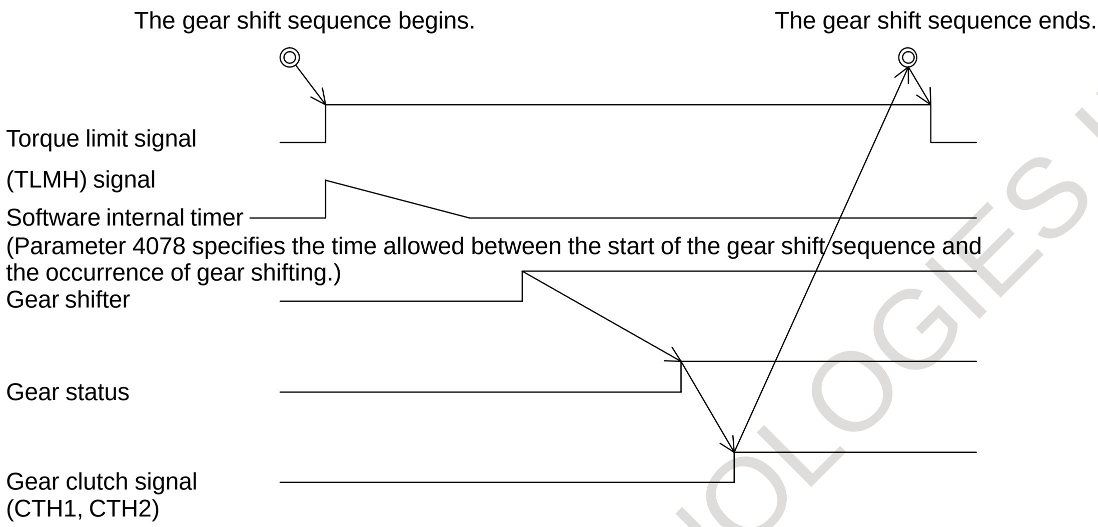
- The Series 9D12 ROM is in use.
- The motor speed obtained from the position coder signal is to be used (bit 0 of parameter 4005 (FS16) = "1").
- The spindle has a gear shift mechanism.

(Descriptions)

If gears are shifted during speed control based on the motor speed obtained from the position coder signal, the gear status of the machine may fail to match the gear ratio parameter setting, resulting in speed control being performed based on the wrong speed data, on which an alarm will be issued. To solve this problem, insert a torque limit signal when gear shifting is started. This measure switches speed control to an inferred speed for smooth gear operation during gear shifting. Parameter 4078 offers a timer that can be used in switching speed control between the motor speed obtained from the position coder signal and the inferred speed. Use the timer if needed.



(Recommended sequence/example: Low gear to high gear)

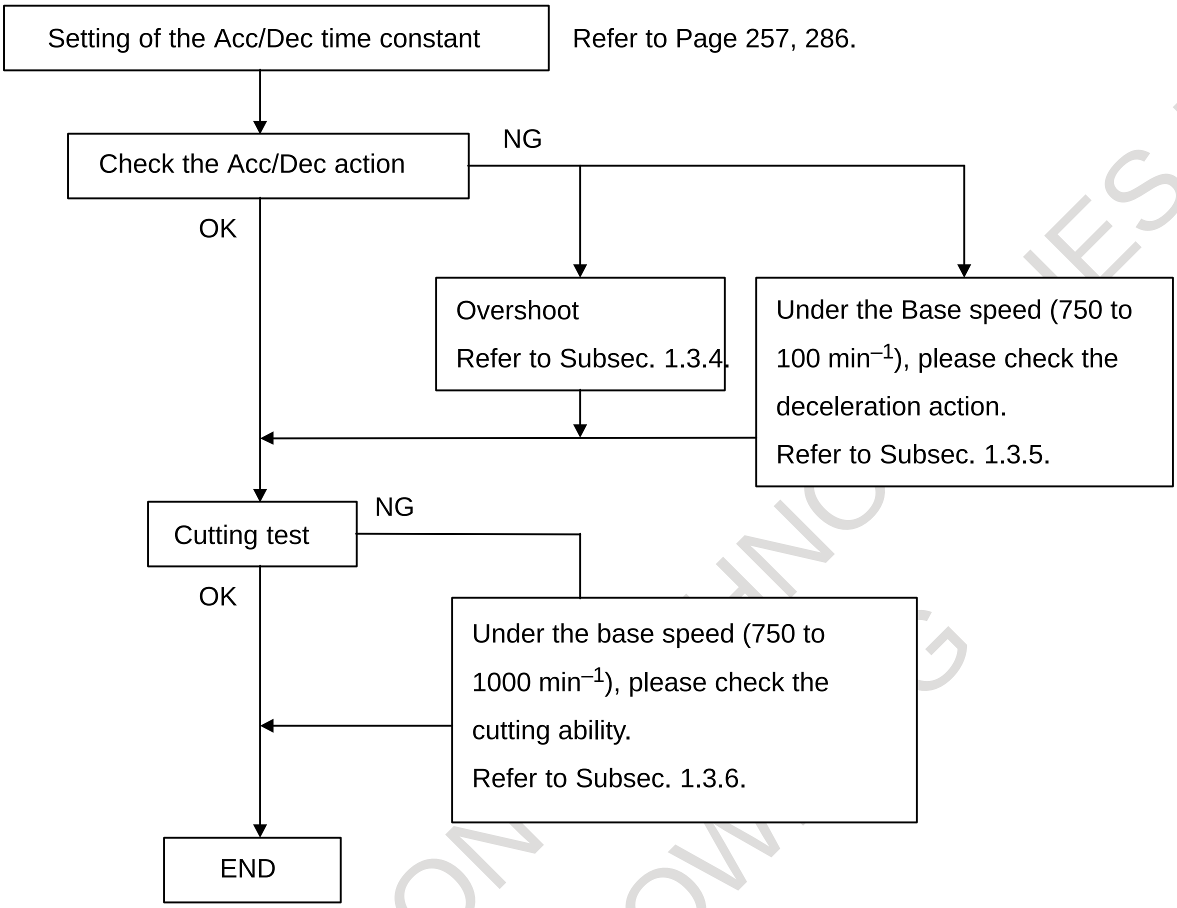


1.2.5 Parameters Related to Normal Operation Mode

(1) Parameters table of the normal operation mode

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st	2nd	1st	2nd			
6505 #0	6645 #0	3005 #0	3145 #0	3005 #0	4005 #0	The motor speed data calculated from the position coder signalis used or not
6540 6541	6680 6681	3040 3041	3180 3181	3040 3041	4040 4041	Velocity loop proportional gain (CTH1=0) on normal operation (CTH1=1)
6548 6549	6688 6689	3048 3049	3188 3189	3048 3049	4048 4049	Velocity loop integral gain (CTH1=0) on normal operation (CTH1=1)
6569	6709	3069	3209	3069	4069	Acceleration/Deceleration time constant (CTH1=0, CTH2=0)
6570	6710	3070	3210	3070	4070	Acceleration/Deceleration time constant (CTH1=0, CTH2=1)
6571	6711	3071	3211	3071	4071	Acceleration/Deceleration time constant (CTH1= 1, CTH2=0)
6572	6712	3072	3212	3072	4072	Acceleration/Deceleration time constant (CTH1=1, CTH2=1)
6546	6686	3046	3186	3046	4046	Velocity error level at the beginning integral gain
6580	6720	3080	3220	3080	4080	Limitation on regenerative power
6583	6723	3083	3223	3083	4083	Motor voltage setting on normal operation

(2) Adjustment and check the normal mode operation.



1.3 PARAMETER ADJUSTMENT

	Symptom	Relevant section
1	The motor does not rotate.	1.3.1
2	The motor does not rotate at the commanded speed.	1.3.2
3	The motor vibrates and generates noise while rotating.	1.3.3
4	Overshoot or hunting occurs.	1.3.4
5	Deceleration time is too long.	1.3.5
6	The cutting capability is sub–standard.	1.3.6
7	Acceleration/deceleration time is too long.	1.3.7
8	LED indicates a status error (Status error indication function).	1.3.8
9	Alarm AL–02, AL–31 (excessive speed deviation), or AL–35 (difference between the inferred speed and the motor speed obtained from the position coder signal is higher than the set level) lights.	1.3.9

1.3.1 The Motor Does Not Rotate

(1) Check all connections.

(a) Motor power line connection.

(b) DC link connection between the power supply module and spindle amplifier module.

(c) The contactor of the Emergency stop.

(2) Check the parameter settings.

(a) Setting of following parameter.

0	15	16	Description
6520	3020	4020	Maximum motor speed
6569 to 6972	3069 to 3072	4069 to 4072	Acceleration/Deceleration time constant (If this data=“0”, motor can not rotate.).

(b) Parameters related to spindle speed commands (See Section 1.2.3.)

(3) Check the Input signal.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
	G229	G227	G070	MRDYA		SFRA	SRVA				
	G230	G226	G071							*ESPA	

Please check the LED status on the SPMC, instead of the indication “00” and the motor does not rotate, please check the velocity command from CNC.

1.3.2 The Motor Does Not Rotate at the Commanded Speed

(1) Setting of following parameter.

0	15	16	Description	Setting data
6511 #3	3011 #3	4011 #3	Poles of motor	1
6520	3020	4020	Maximum motor speed	Set right value
6548 to 6549	3048 to 3030	4048 to 4049	Velocity loop integral gain on normal operation	Set larger value

Parameter related to spindle speed commands. (See Section 1. 2. 3.)

1.3.3 The Motor Vibrates and Generates Noise while Rotating

(1) Setting of following parameter.

0	15	16	Description	Setting data
6540 to 6541	3040 to 3041	4040 to 4041	Velocity loop proportional gain on normal operation	Set smaller value

(2) Compare the conditions when the motor is driven and when the motor is free running. If considerably less vibration and noise is observed while the motor is free running, the control circuit side will be faultly. If the same degree of vibration and noise is observed, the motor or machine will be faultly.

The motor starts free running and alarm is issued if the position feedback cable or over haet cable is desconnected while motor is rotating. Before attempting to go free running, check with the machine tool builder. The machine will stop depending on the sequence.

1.3.4 Overshoot or Hunting Occurs

(1) Check the parameter setting.

(a) Adjust the following parameters.

0	15	16	Description	Setting data
6540 to 6541	3040 to 3041	4040 to 4041	Velocity loop proportional gain on normal operation	Set larger value. (1 to 3 times)
6548 to 6549	3048 to 3049	4048 to 4049	Velocity loop integral gain on normal operation	Adjust the 1 to 2 times of initial value.
6569 to 6572	3069 to 3072	4069 to 4072	Acceleration/Deceleration time constant	Set smaller value.
6583	3083	4083	Motor voltage setting on normal operation	Set larger value. (setting value = 60 to 80)
6546	3046	4046	Velocity error level at the beginning velocity loop integral gain calculation	Set smaller value. (setting value = 100 to 50)

1.3.5 Deceleration Time is Too Long

(1) Check the parameter setting.

(a) Adjust the following parameter.

0	15	16	Description	Setting data
6603	3108	4108	IQCERR clamp slope	Set smaller value.
6569 to 6572	3069 to 3072	4069 to 4072	Acceleration/Deceleration time constant	Set smaller value.
6583	3083	4083	Motor voltage setting on normal operation	Set larger value. (setting value = 60 to 80)

When the load inertia or friction torque is large and decelerate from the 750 to 1000 min^{-1}, the deceleration time is too long. (free running condition will be occurred.)
In this case, please adjust these parameters.

1.3.6 The Cutting Capability is Sub–standard

(1) Check the input signal.

(a) Torque limit command (TLMH)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
	G229	G227	G070							TLMHA	

(2) Check the paramter setting.

0	15	16	Description	Setting data
6540 to 6541	3040 to 3041	4040 to 4041	Velocity loop proportional gain on normal operation	Set larager value(1 to 3times)
6548 to 6549	3048 to 3049	4048 to 4049	Velocity loop integral gain on normal operation	Set larger value(1 to 4times)
6583	3083	4083	Motor voltage setting on normal operation	Set larger value(setting value = 60 to 80)

1.3.7 Acceleration/deceleration Time is Too Long

(1) Check the parameter setting.

(a) Acceleration/Deceleration time constant parameter. (In case of this data is too small, the Acceleration/Deceleration time is increased.)

0	15	16	Description
6569 to 6572	3069 to 3072	4069 to 4072	Acceleration/Deceleration time constant

The initial setting of this parameter is 900 (min^{-1}/sec).
Please set and adjust this parameter depends on the motor output torque and spindle inertia.
Please refer to the section of parameter explanation (Subsec. 1.2.5) in details.

(b) Limitation of regenerative power

(In case of this data is too small, the deceleration time is increased.)

0	15	16*i*/16	Description
6580	3080	4080	Limitatiion of regenerative power

(2) Check the DI signal

(a) Torque limit command (TLMH)

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
	G229	G227	G070							TLMHA	

1.3.8 LED Indicated a Status Error (Status Error Indication Function)

When there is an erroneous parameter setting or the sequence inappropriate, the status error indication function works. If an error occurs, the yellow LED lights and the 7–segment on the front of the spindle amplifier module indicate the error number. When the operation of the spindle motor is defective, check the error number and remove the error by performing the following countermeasures. (This error number is not displayed on the CNC screen.)

LED	Description	Countermeasure
01	Although *ESPJthere are 2 types : connection signal and PMC input signal) and MRDYJmachine ready signal) are not input, SFR/SRV is input.	Check the ladder sequence of *ESP, and MRDY. About MRDY signal, Please check the parameter setting No.4001#0.
04	Although the parameter setting for using position coder (NO.4001#2) is not set, the synchronous command is input. In this case, the motor is not excited.	Check the parameter setting (No.4001#2) which the use of input signal.
05	Although the parameter setting for orientation (NO.4015#0 and CNC software option parameter bit) is not set, the orientation command is input.	Check the parameter setting (No.4015#0, and CNC software option parameter bit) which the use of orientation function.
08	Although the rigid tapping command was input, SFR/SRV is not input.	Check the ladder sequence
09	Although the spindle synchronous control command was input, SFR/SRV is not input.	Check the ladder sequence
11	Rigid tapping command was entered, but the another mode (orientation, spindle synchronization control) command is input.	When the rigid tapping is commanded, do not command the another mode (orientation, spindle synchronization).
12	Spindle synchronous control command was entered, but the another mode (orientation, rigid tapping) command is input.	When the spindle synchronous control is commanded, do not command the another mode (orientation, rigid tapping).
13	Orientation command was entered, but the another mode (rigid tapping, spindle synchronization control) command is input.	When the orientation is commanded, do not command the another mode(rigid tapping, spindle synchronization control).
14	SFR/SRV are simultaneously commanded.	Command only SFR or SRV at one time.
18	Although the parameter setting for using position coder (NO.4001#2) is not set, the orientation command is input.	Check the parameter setting (No.4001#2) which the use of position input signal.

1.3.9 Alarm AL–02, AL–31 (Excessive Speed Deviation), or AL–35 (Difference between the Inferred Speed and the Motor Speed Obtained from the Position Coder Signal Is Higher than the Set Level) Lights. (Series 9D11/G or Later, and Series 9D12/A or Later)

- A system having a position coder issues alarms (AL–02, –31, and –35) based on the motor speed obtained from the position coder. The gear ratio parameter is used in calculating the motor speed. These alarm conditions may be detected mistakenly if the gear ratio or position coder mounting orientation parameter setting is incorrect or if the gear status of the machine does not match the status of the gear clutch signal.

2 EXPLANATION OF FUNCTIONS

2.1 POSITION CODER METHOD SPINDLE ORIENTATION

2.1.1 Start–up Procedure

Parameters are underscored. See Section 2.1.3.

A. Check that the normal operation can be performed.

↓

B. Prepare and check the ladder program for the spindle orientation.
(See Subsec. 11.1.2 in the Descriptions (B–65162E))

↓

C. Set the parameters related to the spindle orientation.
(See section 2.1.3)

↓

D. Check the position coder signal and position coder related parameters.
- Position coder signal is used
- The relationship of the rotation direction between spindle and spindle motor
- Mounting direction of the position coder
- Gear ratio

↓

E. Check whether spindle orientation performed.

NG → back to B.

OK ↓

F. Set and check the rotation of direction at the spindle orientation.
- The rotation of direction at the spindle orientation.

↓

G. Adjust the orientation stop position.
- Orientation completion signal detection level.
- Orientation stop position shift.

↓

H. Adjust the orientation speed. (This is intended to adjust for a spindle speed of 200 min^{-1}.)
- Position gain on orientation.
- Motor speed limit value on orientation.
- Spindle orientation speed.

↓

I. Adjust the orientation stop. (This is intended to prevent overshoot and hunting and to improve rigidity at a stop.)
- Position gain on orientation.
- Spindle orientation deceleration constant.
- Motor voltage setting on orientation.
- Velocity loop proportional and integral gain on orientation.
- Velocity loop imperfect integration coefficient on orientation.

↓

J. Check the ATC operation.

2.1.2 Signals Related to Position Coder Method Spindle Orientation

(1) Input signal (PMC→CNC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st : 2nd:	G110 G112	G231 G239	G230 G238	G078 G080	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
1st : 2nd:	G111 G113	G230 G238	G231 G239	G079 G081					SHA11	SHA10	SHA09	SHA08
1st : 2nd:	G229 G233	G227 G235	G227 G235	G070 G074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	
	G230 G234	G226 G234	G226 G234	G071 G075			INTGA				*ESPA	ARSTA
1st : 2nd:	G231 G235	G229 G237	G229 G237	G072 G076				OVRA		NRROA	ROTAA	INDXA

(Series 9D12 only)

(2) Output signal (CNC→PMC)

	0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
1st : 2nd:	F281 F285	F229 F245	F229 F245	F045 F049	ORARA	TLMA		LDTA	SARA	SDTA	SSTA	ALMA

2.1.3 Parameters Related to Position Coder Method Spindle Orientation

Parameter No.				Description
0	**15**	**15*i***	**16*i*/16**	
6515 #0	3015 #0	3015 #0	4015 #0	Spindle orientation function is use or not (CNC software option) (Set to “1”)
0080	5609	5609 #2	3702 #3, #2	Stop position external setting type spindle orientation is use or not (#2:1st, #3:2nd)
6501 #2	3001 #2	3001 #2	4001 #2	Position coder signal is used or not (Set to “1”)
6500 #2	3000 #2	3000 #2	4000 #2	The mounting direction of position coder
6500 #0	3000 #0	3000 #0	4000 #0	The relationship of the rotation direction between spindle and motor
6503 #3, 2	3003 #3, 2	3003 #3, 2	4003 #3, 2	Setting of rotation direction at spindle orientation
6517 #7	3017 #7	3017 #7	4017 #7	Specifies whether the shortcut function is used when the spindle orientation is performed from the stop state
6531	3031	3031	4031	Position coder method orientation stop position (This parameter is disenabled when 3702#3,#2= “1”(FS16))
6538	3038	3038	4038	Spindle orientation speed
6542, 6543	3042, 3043	3042, 3043	4042, 4043	Velocity loop proportional gain on orientation
6550, 6551	3050, 3051	3050, 3051	4050, 4051	Velocity loop integral gain on orientation
6554	3054	3054	4054	Velocity loop imperfect integration coefficient on orientation
6556 to 6559	3056 to 3059	3056 to 3059	4056 to 4059	Gear ratio
6560 6563	3060 to 3063	3060 to 3063	4060 to 4063	Orientaion completion signal detection level
6575	3075	3075	4075	Orientation completion signal detection level
6576	3076	3076	4076	Motor speed limit value on orientation
6577	3077	3077	4077	Orientation stop position shift value
6579	3079	3079	4079	Position gain switching speed preset value
6584	3084	3084	4084	Motor voltage setting on orientation

Parameter No.				Description
0	15	15*i*	16*i*/16	
6592 to 6595	3092 to 3095	3092 to 3095	4092 to 4095	Spindle orientation deceleration constant
6598	3098	3098	4098	Maximum speed of position coder signal detection

2.2 SPINDLE SYNCHRONIZATION CONTROL (9D12 SERIES ONLY)

2.2.1 Start–up Procedure

Parameters are underscored. See Section 2.2.3.

A. Check that normal operation can be performed.

↓

B. Prepare and check the ladder program for spindle synchronization control.
(See Section 11.4 in the Descrpitions (B–65162E).)

↓

C. Set the parameters related to spindle synchronization control (See Subsec. 2.2.3).

↓

D. Check the position coder signal and position coder related parameters.

- Position coder signal is used
- Use the motor speed obtained from the position coder signal.
- The relationship of the rotation direction between spindle and spindle motor
- Mouting direction of the position coder
- Gear ration

↓

E. Check the spindle synchronization speed. (Set the common spindle speed to that of the spindle whose maximum rotation speed is lower than that of the other spindle.)

↓

F. Set and check the rotation of direction at the spindle synchronization control

- Direction of rotation of the spindle motor while spindle synchronization

↓

G. Check the overshoot or hunting do not occur before the spindle achieves the maximum speed.

- Position gain on servo mode
- Acceleration/Deceleration time constant at spindle synchronization control
- Magnetic flux switching point used for calculating an Acc/Dec time constant at spindle synchronization control
- Bell type Acc/Dec time constant at spindle synchronization control

↓

H. Check the error pulse between spindles is within ±10p.

- Position gain on servo mode
- Gear ratio and Gear ratio setting resolution
- Motor voltage setting on servo mode
- Velocity loop proportional, integral gain on servo mode

↓

I. Check the operation of the spindle phase synchronization control

- Shift amount at spindle phase synchronization
- Spindle phase synchronization compensation data

↓

J. End the checking of the spindle synchronization operation.

2.2.2 Signals Related to Spindle Synchronization Control

(1) Input signal (PMC→CNC)

	0T	0TT	15	16i/16	7	6	5	4	3	2	1	0
	G146	G146		G038					SPPHS	SPSYC		
	G124	G124		G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
	G125	G125		G033			SSGN		R12I	R11I	R10I	R09I
			G025		RI07	RI06	RI05	RI04	RI03	RI02	RI01	RI00
			G024		RISGN			RI12	RI11	RI10	RI09	RI08
			G111		SPPHS	SPSYC						
1st : 2nd:	G229 G233	G229 G1429	G227 G235	G070 074	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	
1st : 2nd:	G230 G234	G230 G1430	G226 G234	G071 G075			INTGA				*ESPA	ARSTA

(2) Output signal (CNC→PMC)

	0T	0TT	15	16	7	6	5	4	3	2	1	0
	F178	F178		F044				SYCAL	FSPPH	FSPSY		
			F111		MSPPHS	MSPSYC	SPSYAL					
1st : 2nd:	F281 F285	F281	F229 F245	F045 F049	ORARA	TLMA		LDTA	SARA	SDTA	SSTA	ALMA

Diagnose

No.			Contents
0–T/TT	**15TT**	**16*i*/16**	
–	DGN1508	–	Sequence state in the spindle synchronization control
DGN754	DGN1509	DGN414	Position error pulse of 1st spindle in the spindle synchronization control
DGN755	DGN1510	DGN415	Position error pulse of 2nd spindle in the spindle synchronization control
DGN756	DGN1511	DGN416	Difference of the position error pulse between two spindle in the spindle synchronization control

2.2.3 Parameters Related to Spindle Synchronization Control

Parameter No.						Description
0T		0TT	FS15TT		16*i*/16	
1st	2nd		1st	2nd		
0080#6	–	0080#6	5820#0	–	4800#0	Direction of rotation of 1st spindle motor while spindle synchronization control
–	0080#7	0080#6	–	5820#1	4800#1	Direction of rotation of 2nd spindle motor while spindle synchronization control
0303		0303	5810		4810	Error pulse between two spindles for turning on the spindle phase synchronizationcompletion signal
0576		0576	5811		4811	Error pulse between two spindles for issuing alarm while spindle synchronization
6532	6672	6532	3032	3172	4032	Acceleration/Deceleration time constant at the spindle synchronization control (Set the same data for 1st and 2nd spindle)
6533	6673	6533	3033	3173	4033	Spindle synchronization speed arrival level
6534	6674	6534	3034	3174	4034	Shift amount at phase synchronization
6535	6675	6535	3035	3175	4035	Spindle phase synchronization compensation
6544 to 6545	6684 to 6685	6544 to 6545	3044 to 3045	3184 to 3185	4044 to 4045	Velocity loop proportional gain on servo mode
6552 to 6553	6692 to 6693	6552 to 6553	3052 to 3053	3192 to 3193	4052 to 4053	Velocity loop integral gain on servo mode
6505#0	6645#0	6505#0	3005#0	3145#0	4005#0	The motor speed data calculated from the position coder signal is used (Set to "1")
6506#1	6646#1	6506#1	3006#1	3146#1	4006#1	Gear ratio setting resolution
6556 to 6559	6696 to 6699	6556 to 6559	3056 to 3059	3196 to 3199	4056 to 4059	Gear ratio
6565 to 6568	6705 to 6708	6565 to 6568	3065 to 3068	3205 to 3208	4065 to 4068	Position gain on servo mode (Set the same data for 1st and 2nd spindle)
6506#4	6646#4	6506#4	3006#4	3146#4	4006#4	Setting for function performing automatic detection of the one–rotation signal
6585	6725	6585	3085	3225	4085	Motor voltage setting on servo mode
6300	6480	6300	3480	3700	4336	Magnetic flux switching point used for calculating an acceleration/deceleration timeconstant on spindle synchronization control(Set the same data for 1st and 2nd spindle)
6304	6484	6304	3484	3704	4340	Bell type Acc/Dec time constant on spindle synchronization control (Set the same data for 1st and 2nd spindle)

2.3 Rigid Tapping (9D12 Series Only)

2.3.1 Start–up Procedure

Parameters are underscored. See Section 2.3.2.

A.Check that normal operation can be performed.

↓

B.Prepare and check the ladder program for Rigid tapping.
(See Sec. 11.2 in the Descriptions (B–65162E).)

↓

C.Set the parameters related to Rigid tapping
- The motor speed data calculated from the position coder signal is used
- The relationship of the rotation direction between spindle and spindle motor
- Mounting direction of the position coder
- Gear ratio
- Position gain on rigid tapping
- Acc/Dec time constant on rigid tapping
- Maximum spindle speed on rigid tapping

↓

D.Check the velocity error of the spindle motor during the rigid tapping
- Velocity loop proportional, integral gain on servo mode(rigid tapping)
- Motor voltage setting on servo mode(rigid tapping)
- Position gain on rigid tapping

↓

E.Check the torque command.
- Acc/Dec time constant on rigid tapping

↓

F.Check the position error of the spindle motor during the rigid tapping
- Position gain on rigid tapping
- Gear ratio

↓

G. Check spindle switching operation.
- Position gain on rigid tapping
- Acc/Dec time constant on rigid tapping
- others

NOTE

1 When the rigid tapping function is used in the αC series spindle system, it is available that the spindle configuration which linked spindle and the position coder at 1:1 only. So, the arbitrary gear ratio setting is not available.

2 About the parameter setting and adjustment, please refer to the parameter manual of α series spindle (B–65160E etc.) in details.

2.3.2 Parameters Related to Rigid Tapping

Parameter No.					Description
0M/T/TT		15M/T	15*i*	16*i*/16 M/T/TT	
1st	2nd				
0256		–	–	5210	M code for the rigid tapping command
0031#5 (T)		–	–	–	Address selection of gear signal
0019#4 (M)		–	–	–	Selects DI signal in the rigid tapping mode
6501#2	6641#2	3001#2	3001#2	4001#2	Position coder signal is use or not (Set to “1”)
6505#0	6645#0	3005#0	3005#0	4005#0	The motor speed data calculated from the position coder signal is used or not (Set to “1”)
6500#0	6640#0	3000#0	3000#0	4000#0	Relationship of the rotation direction between spindle and spindle motor
6500#2	6640#2	3000#2	3000#2	4000#2	The mounting direction of position coder
28#7,6 03#7,6	64#7,6	5610	–	3706 #1,0 3707 #1,0	Gear ratio between spindle and position coder (Available “×1” only)
–	–	–	5842	–	Number of pulse of the position coder
6556 to 6559	6696 to 6699	3056 to 3059	3056 to 3059	4056 to 4059	Gear ratio (Spindle–to–motor)
(M) 615 669 670 671	(T) 406 to 410	3065 to 3068	3065 to 3068	5280 5281 to 5284	Position gain in the rigid tapping for the tapping axis
6565 to 6568	6705 to 6708	3065 to 3068	3065 to 3068	4065 to 4068	Position gain in the rigid tapping for the spindle
37#6		–	–	–	Stepless time constant selection (set to “1”)
254		5605#1	5605#1	–	Acc/Dec type (set to “1” : Linear type)
(M) 613	(T) 415 to 418	5605#2 5751 5760 5762 5764	5605#2 5751 5886 5889 5892	5261 5262 5263 5263 5264	Acceleration/Deceleration time constant
(M) 617	(T) 423 to 426	5605#2 5757 5758 5759	5605#2 5757 5884 5887 5890 5893	5241 5242 5243 5244	Maximum spindle speed in the rigid tapping
63#4		–	–	5200#4	Selects override during extraction
258		–	5883	5211	Override value in extraction
–		–	–	5201#2 5271 to 5274	Acceleration/Deceleration time constant during extraction
618		1827	1827	5300	In–position width for the tapping axis
619		5755	5875	5301	In–position width for the spindle

Parameter No.					Description
OM/T/TT		15M/T	15i	16i/16 M/T/TT	
1st	2nd				
620		1837	1837	5310	Allowable level of position error of tapping axis at moving
621		5754	5876	5311	Allowable level of position error of spindle at moving
622		–	1829	5312	Allowable level of position error of spindle at moving
623		–	5877	5313	Allowable level of position error of spindle at stop
(M) 255	(T) 214 to 217	5604#2 5756 5791 to 5794	5853 5856 5859 5862	5321 to 5324	Spindle backlash value
6544 6545	6684 6685	3044 3045	3044 3045	4044 4045	Velocity loop proportional gain on servo mode (rigid tapping)
6552 6553	6692 6693	3052 3053	3052 3053	4052 4053	Velocity loop integral gain on servo mode (rigid tapping)
6585	6725	3085	3085	4085	Motor voltage setting on servo mode (rigid tapping)
6597	6737	3097	3097	4097	Delay time for motor excitation
–		–	–	5204#0	Diagnose display method of synchronization error on rigid tapping (Set to 0.)

Diagnose

Parameter No.					Description
OM/T/TT		15M/T	15i	16i/16 M/T/TT	
1st	2nd				
DGN800 to 802	DGN800 to 801	DGN3000	–	DGN300	Position error pulse of the tapping axis (pulse)
PRM627	PRM435	DGN3000	–	DGN450	Position error pulse of the spindle (pulse)
PRM628	PRM436	–	–	DGN451	Interpolation pulse of the spindle (pulse)
PRM696	PRM437	–	–	DGN452	Instant value of the position error difference between the tapping axis and the spindle (%) (Conventional spec.:PRM5204#0=1)
PRM697	PRM438	–	–	DGN453	Maximum value of the position error difference between the tapping axis and the spindle (%) (Conventional spec.:PRM5204#0=1)
PRM799		–	–	DGN454	Integrated interpolation pulse of spindle (pulse)
–		–	–	DGN455	Instant value of the position command difference between the tapping axis (reflected to the spindle one rotation 4096 pulse) and the spindle. (New spec.:PRM5204#0=0) (pulse)
–		–	–	DGN456	Instant value of the position error difference between the tapping axis (reflected to the spindle one rotation 4096 pulse) and the spindle. (New spec.:PRM5204#0=0) (pulse)
–		–	–	DGN457	Maximum width of synchronization error on the rigid tapping (New spec.:PRM5204#0=0) (pulse)

3 EXPLANATION OF PARAMETERS

This chapter describes all spindle parameters.

(1) The parameter numbers given in description below are those for the Series 16*i*/16. Note that when using another series CNC, the parameter numbers are differ.

(2) The parameter numbers indicated in the upper row are used for the 1st spindle, while those indicated in the lower row are used for the 2nd spindle.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6500 6640	3000 3140	3000	4000				RETSV		POSC1		ROTA1

Standard setting:	0	0	0	0	0	0	0	1

ROTA1: The relationship of the rotation direction between spindle and spindle motor

0: Rotates the spindle and spindle motor in the same direction

1: Rotates the spindle and spindle motor in the reverse direction

POSC1: The mounting direction of the position coder

0: Rotates the spindle and position coder in the same direction

1: Rotates the spindle and position coder in the reverse direction

RETSV:

The reference point return direction on servo mode(rigid tapping) (9D12 series only)

0: Spindle reference point returns CCW

1: Spindle reference point returns CW

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6501 6641	3001 3141	3001	4001						POSC2		MRDY1

Standard setting:	0	0	0	0	0	0	0	1

MRDY1: MRDY signal (machine ready signal) is used or not

0: Not used (The MRDY signal should be always set to “1”)

1: Used.

POSC2: Position coder signal is used or not

0: Not used.

1: Used.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6503 6643	6503 3143	3003	4003					DIRCT2	DIRCT1		

Standard setting:	0	0	0	0	0	0	0	1

DIRCT2, 1:

Setting of rotation direction at the spindle orientation

00 :By rotation direction immediately before (1st time CCW)

01 :By rotation direction immediately before (1st time CW)

10 :CCW (counterclockwise) direction looking from shaft from motor

11 :CW (clockwise) direction looking from shaft from motor

> **NOTE**
> If the parameter is set to “by rotation direction immediately before,” “rotation direction immediately before” is decided on when the rotation speed is not lower than the zero–speed detection level (SST = 0).

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6505 6645	3005 3145	3005	4005								PCFB

Standard setting:	0	0	0	0	0	0	0	0

PCFB:

The motor speed data calculated from the position coder signal is used or not (9D12 series only)

0: Not used. (use the estimated speed as same as 9D11 series)

1: Used.

When the rigid tapping or the spindle synchronization control is used, please this bit sets to “1”. In the normal operation mode, if this bit sets to “1”, it will be able to improve the stability and response. (But, it will depend on the linked ratio and rigidity between spindle – motor – position coder.)

0			16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6506 6646	3006 3146	3006	4006		CKBD	ALGOVR		SYCREF		GRUINT	

Standard setting:	0	0	0	0	0	0	0	0

GRUNIT: Gear ratio setting resolution

0: 1/100 units

1: 1/1000 units

This parameter is used for gear ratio setting to select whether to set the number of motor revolution for 1 revolution of spindle as a multiple of 100 or 1000. When the gear ratio is a fraction at 1/100, there may be a constant synchronization error indicated in spindle synchronization control. In this sort of situation using setting units of 1/1000 makes the synchronization error appear much smaller. These parameters change the following parameter setting.

Parameter No.						Description
0		15		15*i*	16*i*/16	
1st	2nd	1st	2nd			
6556 to 6559	6696 to 6699	3056 to 3059	3196 to 3199	3006 to 3059	4056 to 4059	Gear ratio

SYCREF:

Setting for function performing automatic detection of the one–rotation signal in spindle synchronization control

0: Automatic detection of the one–rotation signal carried out

1: Automatic detection of the one–rotation signal not carried out (When spindle phase synchronization is not carried out)

If an attempt is made to switch to the spindle synchronization mode after the power is turned on, each spindle automatically tries to detect a one–rotation signal to locate it. (Even if you do not intend, the spindle automatically makes 2 to 3 turns.) This is because spindle phase synchronization requires that a one–rotation signal be detected in advance. This operation is disabled by setting this data to “1” if it should not be performed, for example, because the spindles are mechanically coupled and this operation is harmful or because spindle phase synchronization is not to be performed.

ALGOVR:

Setting of the spindle analog override range

0: 0 to 100%

1: 0 to 120%

CKBD:

Setting of the spindle checkboard data output (9D12 series only)

0: The data is output in normal operation mode only. (Not output in orientation, rigid tapping and spindle synchronization control.)

1: The data is output not only in normal operation mode, but also in orientation, rigid tapping and spindle synchronization control.

Normally, please set “0”.

When the data is measured with the spindle checkboard in the orientation, rigid tapping and spindle synchronization control, please set “1” to this bit parameter. After measurement, please set “0” again absolutely. If not, there is a case that AL–53 occurrs.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6507 6647	3007 3147	3007	4007		PCALCH	PCLS	FRQLM				

Standard setting:	0	0	0	0	0	0	0	0

FRQLM: Setting of the SM terminal data

0: Speed meter data (SM terminal works for the speed meter)

1: Load meter data (SM terminal works for the load meter)

PCLS: Determines the position coder signal disconnection (AL–27) detection

0: Performs disconnection detection (Set to 0 usually)

1: Not performs disconnection detection

PCALCH: Enables or disables detection of the alarm (AL–41,42,47) related to the position coder signals

0: Detects the alarms related to the position coder signal (Set to 0 usually)

1: Does not detects the alarms related to the position coder signal

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6509 6649	3009 3149	3009	4009		OVRTYP		LDTOUT		ALSP		

Standard setting:	0	0	0	0	0	0	0	0

ALSP: Specifies how to turn off the power to motor when AL–24 (Serial transfer data error) is occurred

0: The power to the motor is turned off once the motor has been decelerated and stopped

1: The power to the motor is turned off immediately

(Set this bit to “1” to turned off the power to the motor immediately upon occur of the spindle alarm)

LDTOUT:

Specifies whether the load detection signal (LDTA) is output during acceleration/deceleration

0: Not output during acceleration/deceleration

1: Output (at all time) during acceleration/deceleration if the level set in the parameter is exceeded.

OVRTYP:

Specifies the analog override type

0: Override of linear function type

1: Override of quadratic function type

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6511 6651	3011 3151	3011	4011			ADJG	MXPW	POLE1			

Standard setting:	0	0	X	X	1	0	0	0

POLE1: Number of motor poles

POLE1	poles
1	4 poles

MXPW: Setting of maximum output when accelerates and decelerates

X: Depends on the motor model

ADJG: Setting of acceleration and deceleration judging conditions on maximum output when accelerates and decelerates

X: Depends on the motor model

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6513 6653	3013 3153	3013 3153	4013			DS4	DS3	DS2	DS1	ESED	ESEC
Standard setting:				0	0	X	X	X	X	X	0

ESEC:

0: CCW=Rising edge CW=Falling edge (Normally set to ”0”)

1: CCW, CW=Rising edge

DS4-DS0:

Setting of current dead band data
Depends on the spindle amplifier module

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6515 6655	3015 3155	3015 3155	4015								ORIENT
Standard setting:				0	0	0	0	0	0	0	0

ORIENT:

Presence of spindle orientation function (CNC software option)

0: Without spindle orientation function

1: With spindle orientation function

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6516 6656	3016 3156	3016 3156	4016	RFCHK3	RFCHK2						
Standard setting:				0	0	0	0	0	0	0	0

RFCHK2:

Precence of one rotation signal error detection function for positon coder signal

0: One rotation signal error detection function (AL–46) not present.

1: One rotation signal error detection function (AL–46) present.

RFCHK3:

Presence of function for redetection the one rotation signal for the position coder signal each time spindle orientation/spindle synchronization mode is entered.

0: The one rotation signal is not detected each time the operating mode changes (Once the one rotation signal has been detected, it is not detected again until the power goes off)

1: The one rotation signal is detected each time the operating changes.

0	15	15*i*	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6517 6657	3017 3157	3017	4017	NRROEN							

Standard setting:	0	0	0	0	0	0	0	0

NRROEN:

Specifies whether the shortcut function is used when the spindle orientation by position coder is performed from the stop state.

0: Not used.

1: Used.

When this bit is set to "1", the shortcut function is used when the following requirements are satisfied.

- Parameter NO.4016#7 (RFCHK3) ="0"
- Speed zero detection signal (SST) ="1"
- The shortcut command NRRO ="1"

0	16*i*/16	#7	#6	#5	#4	#3	#2	#1	#0
6519 6659	4011	PRLOAD							

Standard setting:	0	0	0	0	0	0	0	0

PRLOAD:

Parameter automatic setting function (Series 0, Series 16, 18, 20, 21, Power Mate)

0: Parameter automatic setting function is not executed

1: Parameter automatic setting function is executed

Set the model code parameter PRM6633 (Series0),PRM4133 (Series16 etc.),,and set this bit to "1". Then turn the CNC off, then on again. The spindle parameters are automatically initialized. Upon the completion of automatic parameter initialization , this bit automatically reset to "0".

NOTE

With Series 15, the different parameter address, PRM5607#0 is used this function. Note also that setting function is reversed. Set the model code parameter PRM3133 (Series 15).

0: Parameter automatic setting function is executed

1: Parameter automatic setting function is not executed

0	15	15*i*	16*i*/16	
6520 6660	3020 3160	3020	4020	Maximum speed

Data unit : 1 min^{-1}

Data range : 0 to 32767

Standard setting : Depends on a motor model.

This data is used to set the maximum speed of the spindle motor.

In the ROM version 9D11, the spindle control software estimates the motor speed from the motor current and has the velocity loop using the estimated speed.

0	15	15*i*	16*i*/16	
6522 6662	3022 3162	3022	4022	Speed arrival detection level

Data unit : 0.1%

Data range : 0 to 1000

Standard setting : 150

This data is used to set the detecting range of the speed arrival detection signal (SAR).

When the estimated speed reached the range within ± (setting data/10)% of commanded speed, the bit of the speed arrival detection signal (SAR) is set to "1".

Example

Commanded speed=3000 min^{-1}, Speed arrival level=150

→ 3000 min^{-1} × 150/1000 = <u>450 min^{-1}</u>

0	15	15*i*	16*i*/16	
6523 6663	3023 3163	3023	4023	Speed detecting level

Data unit : 0.1%

Data range : 0 to 1000

Standard setting : 30

This data is used to set the detecting range of the speed detection signal (SDT).

When the estimated speed reached (setting data/10)% or less of maximum speed, the bit of the speed detection signal (SDT) is set to "1".

Example

Maximum speed=6000 min^{-1}, Speed detecting level=30

→ 6000 min^{-1} × 30/1000 = <u>180 min^{-1}</u>

0	15	15*i*	16*i*/16	
6524 6664	3024 3164	3024	4024	Speed zero detecting level

Data unit : 0.01%
Data range : 0 to 10000
Standard setting : 75

This data is used to set the detecting range of the speed zero detection signal (SST).
When the estimated speed reached (setting data/100)% or less of maximum speed, the bit of the speed zero detection signal(SST) is set to ”1”.

Example

Maximum speed=6000 min^{-1}, Speed zero detecting level=75
→ 6000 min^{-1} × 75/10000 = 45 min^{-1}

0	15	15*i*	16*i*/16	
6525 6665	3025 3165	3025	4025	Setting of torque limit value

Data unit : 1%
Data range : 0 to 100
Standard setting : 50

This data is used to set the torque limit value for maximum output torque when the torque limit command (TLMH) is commanded. Data represents limiting value the maximum torque is assumed to be 100%.

TLMH	Details
0	No torque limitation exists.
1	Torque limited exists.

0	15	15*i*	16*i*/16	
6526 6666	3026 3166	3026	4026	Load detecting level 1

Data unit : 1%
Data range : 0 to 100
Standard setting : 83

This data is used to set the detecting range of load detect signal (LDT). When the motor power reaches the setting data % or more of maximum power, the bit of load detect signal (LDT) is set to ”1”.

0	15	15*i*	16*i*/16	
6531 6671	3031 3171	3031	4031	Position coder method orientation stop position

Data unit : 1 pulse (360˚/4096)
Data range : 0 to 4095
Standard setting : 0

This data is used to set the stop position of position coder method orientation. When the stop position external command type spindle orientation is set, this parameter becomes invalid. 12 bit stop position command (SHA11 to SHA00) instructed by PMC becomes valid.

0	15	15*i*	16*i*/16	
6532	3032 6672	3032 3172	4032	Acceleration/deceleration time constant at spindle synchronization control

Data unit : 1 min^{-1}/sec
Data range : 0 to 32767
Standard setting : 0

WheWhen the synchronization speed command at the spindle synchronization control is changed, this acceleration/deceleration time constant parameter is valid.
Set Set exactly the same data for 1st and 2nd spindle.

0	15	15*i*	16*i*/16	
6533 6673	3033 3173	3033	4033	Spindle synchronization speed arrival level

Data unit : 1 min^{-1}
Data range : 0 to 32767
Standard setting : 10

For the synchronization speed command at the spindle synchronization control, if the deviations of the respective spindle motor speeds are within the setting level, the spindle synchronization speed control complete signal becomes “1”.

0	15	15*i*	16*i*/16	
6534 6674	3034 3174	3034	4034	Shift amount at spindle phase synchronization control

Data unit : 1 pulse (360°/4096)
Data range : 0 to 4095
Standard setting : 0

Set the shift amount from the reference point (one rotation signal) at the spindle phase synchronization control.

0	15	15*i*	16*i*/16	
6535 6675	3035 3175	3035	4035	Spindle phase synchronization compensation data

Data unit : 1 pulse/2 msec
Data range : 0 to 4095
Standard setting : 10

This parameter reduces speed fluctuation when the spindle phase synchronization control is executed.
If this parameter is "0", a speed fluctuation for phase matching becomes large because the phase synchronization compensation data is specified at a time, resulting in a steep increase in a phase deviation.
Smooth phase matching can be achieved by dividing the phase synchronization compensation data by the number of pulses specified in the parameter and specifying the resulting smaller amount at 2 ms intervals.

0	15	15*i*	16*i*/16	
6538 6678	3038 3178	3038	4038	Spindle orientation speed

Data unit : 1 min^{-1}
Data range : 0 to 32767
Standard setting : 0

This parameter sets the orientation speed at the spindle.
When this parameter is set to "0", the orientation speed is determined by parameters such as parameter No.4076,4060 to 4063 etc.

0	15	15*i*	16*i*/16		
6540 6680	3040 3180	3040	4040	Velocity loop proportional gain on normal operation (HIGH)	CTH1 = 0
6541 6681	3041 3181	3041	4041	Velocity loop proportional gain on normal operation (LOW)	CTH1 = 1

Data unit : –
Data range : 0 to 32767
Standard setting : Depends on the motor model

This data is used to set the velocity loop proportional gain on normal operation.
When the load inertia is large, the velocity loop proportional gain can be increased.
This parameter is selected by the input signal CTH1.

0	15	15*i*	16*i*/16		
6542 6682	3042 3182	3042	4042	Velocity loop proportional gain on orientation (HIGH)	CTH1 = 0
6543 6683	3043 3183	3043	4043	Velocity loop proportional gain on orientation (LOW)	CTH1 = 1

Data unit : –
Data range : 0 to 32767
Standard setting : Depends on the motor model

This data is used to set the velocity loop proportional gain on orientation. When the load inertia is large, the velocity loop proportional gain can be increased. If the hunting is occurred at the orientation stop, please increase this parameter value. (About 2 to 10 times the standard setting)
This parameter is selected by the input signal CTH1.

0	15	15*i*	16*i*/16		
6544 6684	3044 3184	3044	4044	Velocity loop proportional gain on servo mode (HIGH)	CTH1=0
6545 6685	3045 3185	3045	4045	Velocity loop proportional gain on servo mode (LOW)	CTH1=1

Data unit : –
Data range : 0 to 32767
Standard setting : Depends on the motor model

This data is used to set the velocity loop proportional gain on servo mode (rigid tapping, spindle synchronization control).
When the load inertia is large, the velocity loop proportional gain can be increased.
This parameter is selected by the input signal CTH1.

0	15	15*i*	16*i*/16	
6546 6686	3046 3186	3046	4046	Velocity error level at the beginning velocity loop integral gain calculation

Data unit : min^{-1}
Data range : 0 to 32767
Standard setting : 100

0	15	15*i*	16*i*/16		
6548 6688	3048 3188	3048	4048	Velocity loop integral gain on normal operation (HIGH)	CTH1=0
6549 6689	3049 3189	3049	4049	Velocty loop integral gain on normal operation (LOW)	CTH1=1

Data unit : –
Data range : 0 to 32767
Standard setting : Depends on the motor model

This data is used to set the velocity loop integral gain on normal operation. When the load inertia is large, the velocity loop integral gain can be increased.
This parameter is selected by the input signal CTH1.

0	15	15*i*	16*i*/16	
6550 6690	3050 3190	3050	4050	Velocity loop integral gain on orientation (HIGH) CTH1=0
6551 6691	3051 3191	3051	4051	Velocity loop integral gain on orientation (LOW) CTH1=1

Data unit : -
Data range : 0 to 32767
Standard setting : Depends on the motor model

This data is used to set the velocity loop integral gain on orientation.
When the load inertia is large, the velocity loop integral gain can be increased.
This parameter is selected by the input signal CTH1.

0	15	15*i*	16*i*/16	
6552 6692	3052 3192	3052	4052	Velocity loop integral gain on servo mode (HIGH) CTH1=0
6553 6693	3053 3193	3053	4053	Velocity loop integral gain on servo mode (LOW) CTH1=1

Data unit : -
Data range : 0 to 32767
Standard setting : Depends on the motor model

This data is used to set the velocity loop integral gain on servo mode(rigid tapping, spindle synchronization control).
When the load inertia is large, the velocity loop integral gain can be increased.
This parameter is selected by the input signal CTH1.

0	15	15*i*	16*i*/16	
6554 6694	3054 3194	3054	4054	Velocity loop imperfect integration coefficient on orientation

Data unit : -
Data range : 0 to 32767
Standard setting : 0

This data is used to reduce the hunting at the orientation stop.
The setting data is about 32700 to 32600.

0	15	15*i*	16*i*/16	
6556 6696	3056 3196	3056	4056	Gear ratio (HIGH) CTH1 = 0, CTH2 = 0
6557 6697	3057 3197	3057	4057	Gear ratio (MEDIUM HIGH) CTH1 = 0, CTH2 = 1
6558 6698	3058 3198	3058	4058	Gear ratio (MEDIUM LOW) CTH1 = 1, CTH2 = 0
6559 6699	3059 3199	3059	4059	Gear ratio (LOW) CTH1 = 1, CTH2 = 1

Data unit : PRM4006#1 (GRUNIT) = “0”
→ (Motor rotation for one rotation of spindle) × 100
PRM4006#1 (GRUNIT) = “1”
→ (Motor rotation for one rotation of spindle) × 1000

Data range : 0 to 32767

Standard setting : 100

These data are used to set the gear ratio between spindle and spindle motor.

Example

When the spindle rotates once, set 250 as the data when the motor rotates 2.5 times

This parameter is selected by the input signal CTH1,CTH2.
Set the gear or clutch status to correspond to the clutch/gear signal (CTH1,CTH2).

This parameter is used to calculate the motor speed data from the position coder signal, so please set exactly value. If not, AL–02, 31, 35 may occurr. (In th edition G or later of 9D11, or the edition A or later of 9D12)

0	15	15*i*	16*i*/16	
6560 6700	3060 3200	3060	4060	Position gain on orientation (HIGH) CTH1 = 0, CTH2 = 0
6561 6701	3061 3201	3061	4061	Position gain on orientation (MEDIUM HIGH) CTH1 = 0, CTH2 = 1
6562 6702	3062 3202	3062 3202	4062	Position gain on orientation (MEDIUM LOW) CTH1 = 1, CTH2 = 0
6563 6703	3063 3203	3063	4063	Position gain on orientation (LOW) CTH1 = 1, CTH2 = 1

Data unit : 0.01 sec $^{-1}$

Data range : 0 to 32767

Standard setting : 1000

These data are used to set the position gain on spindle orientation.
This parameter is selected by the input signal CTH1,CTH2.

0	15	15*i*	16*i*/16	
6565 6705	3065 3205	3065	4065	Position gain on servo mode (HIGH) CTH1 = 0, CTH2 = 0
6566 6706	3066 3206	3066	4066	Position gain on servo mode (MEDIUM HIGH) CTH1 = 0, CTH2 = 1
6567 6707	3067 3207	3067	4067	Position gain on servo mode (MEDIUM LOW) CTH1 = 1, CTH2 = 0
6568 6708	3068 3208	3068	4068	Position gain on servo mode (LOW) CTH1 = 1, CTH2 = 1

Data unit : 0.01 sec $^{-1}$

Data range : 0 to 32767

Standard setting : 1000

These data are used to set the position gain on servo mode (rigid tapping, spindle synchronization control).
This parameter is selected by the input signal CTH1,CTH2.

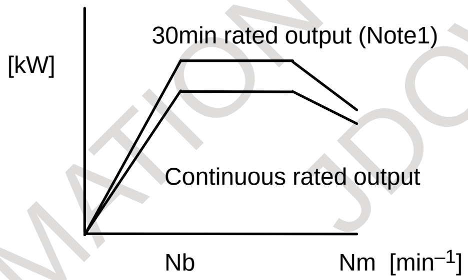
0	15	15*i*	16*i*/16	
6569 6709	3069 3209	3069	4069	Acceleration/Deceleration time constant (HIGH) CTH1 = 0, CTH2 = 0
6570 6710	3070 3210	3070	4070	Acceleration/Deceleration time constant (MEDIUM HIGH) CTH1 = 0, CTH2 = 1
6571 6711	3071 3211	3071	4071	Acceleration/Deceleration time constant (MEDIUM LOW) CTH1 = 1, CTH2 = 0
6572 6712	3072 3212	3072	4072	Acceleration/Deceleration time constant (LOW) CTH1 = 1, CTH2 = 1

Data unit : min^{-1}/sec
Data range : 0 to 32767
Standard setting : 900

The ability of acceleration/deceleration of the α C series is depends on the acceleration/deceleration time constant parameter. The setting of this parameter is determined by the motor torque and spindle inertia. The initial setting of this parameter is 900(rpm/sec), so we have to set and adjust this parameter by the 30min rated torque and spindle inertia on each machine.

Example

Motor output characteristic



Acc/Dec time constant =Tc[min^{-1}/sec]
Rotor inertia =Jm[kg cm sec^2]
Load inertia =JL[kg cm sec^2]
(Converted to motor shaft)
30min rated output =P [kW]
30min rated torque =T [kg m]

$$\boxed{T[kg\,m] = P[kW]/N[min^{-1}] \times 1000/1.0269}$$

Note1) There is 10min or 15min rated output depending on the motor model

$$Acc\,/\,Dec\_time\_const{:}Tc\ [min^{-1}\,/\,\mathrm{sec}] = \frac{100}{(Jm + JL)[kgcm\,\mathrm{sec}^2]} \times T\ [kgm] \times \frac{60}{2\pi}$$

- The initial setting of this parameter :
  N[min^{-1}]=Nm[min^{-1}], Jm+JL=Jm+3*Jm
- The maximum setting of this parameter is determined by the 30min output torque at the base speed(Nb) and spindle inertia.

[Rotor inertia and torque data of the Standard motor model]

Motor model	αC1	αC1.5	αC2	αC3	αC6	αC8	αC12	αC15	αC18	αC22
Jm[kg cm sec^2]	0.03	0.04	0.08	0.15	0.22	0.28	0.93	0.93	1.29	1.29
30min rated torque at Nb(min^{-1}) : T[kg m]	0.71	2.40	2.40	3.57	4.87	7.14	9.74	12.01	14.28	16.88

0	15	15*i*	16*i*/16	
6573 6713	3073 3213	3073	4073	Grid shift amount in servo mode (9D12 series only)

Data unit : 1 pulse unit (360°/4096)
Data range : 0 to 4095
Standard setting : 0
Set this parameter when shifting reference point in servo mode (rigid tapping).
Spindle reference point shifts for set pulse in CCW direction.

0	15	15*i*	16*i*/16	
6574 6714	3074 3214	3074	4074	Speed for return to reference point in servo mode (9D12 series only)

Data unit : min^{-1}
Data range : 0 to 32767
Standard setting : 0
When this parameter is set to "0".
In the reference point return in servo mode (rigid tapping), the spindle speed depends on
PRM4076 (Motor speed limit value on orientation) and PRM4065 to 4068 (Position gain on servo mode).
When this parameter is set to a value other than 0.
In the reference point return in servo mode (rigid tapping), the spindle speed depends on this parameter.

0	15	15*i*	16*i*/16	
6575 6715	3075 3215	3075	4075	Orientation completion signal detection level

Data unit : 1 pulse (360°/4096)
Data range : 0 to 100
Standard setting : 10
This data is used to set the detecting level of orientation completion signal (ORAR).
When the spindle position is located within the setting data on orientation completion, the bit of orientation completion signal (ORAR) is set to "1".

0	15	15*i*	16*i*/16	
6576 6716	3076 3216	3076	4076	Motor speed limit value on orientation

Data unit : 1%
Data range : 0 to 100
Standard setting : 33
This data is used to set the motor speed value on orientation.

Orientation speed (min^{-1})
= Position gain (sec^{-1}) $\times$ gear ratio $\times$ 60 $\times$ (setting data) /100

0	15	15*i*	16*i*/16	
6577 6717	3077 3217	3077	4077	Orientation stop position shift value

Data unit : 1 pulse
Data range : – 4095 to 4095
Standard setting : 0
In position coder method orientation, set this data to shift stop position. Spindle is shift number of setting pulse in CCW direction, and stop by +data.

0	15	15*i*	16*i*/16	
6578 6718	3078 3218	3078	4078	In the torque limit (TLM=1), the timer setting that the change the motor speed data between estimated speed and motor speed calculated from position coder signal (9D12 series only)

Data unit : sec
Data range : 0 to 500
Standard setting : 0
When the spindle has the gear change mechanism, please refer to our recommended gear change sequence for smooth gear change. In our recommended sequence, this parameter is used.

0	15	15*i*	16*i*/16	
6579 6719	3079 3219	3079	4079	Position gain switching speed preset value

Data unit : 1 min^{-1}
Data range : 0 to 32767
Standard setting : 0
This parameter is used for the position gain polygonal line function in the position coder method spindle orientation.
This function doubles the position gain in low speed range.

0	15	15*i*	16*i*/16	
6580 6720	3080 3220	3080	4080	Limitation of regenerative power

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model
This parameter is used to set the regenerative power limit.
Set the standard value for each motor model.

0	15	15*i*	16*i*/16	
6581 6721	3081 3221	3081	4081	Delay time until the motor power is cut off

Data unit : 10 msec
Data range : 0 to 1000
Standard setting : 20 (200 msec)
The motor power is cut off after stopping the motor (Speed zero detection signal SST=1 is detected). However, when the power is cut off immediately after detecting the speed zero signal, the motor may be free running at the low speed. So, detect the speed zero signal and then set the time until the motor power is cut off by this parameter.

0	15	15*i*	16*i*/16	
6582 6722	3082 3222	3082	4082	Time setting during acceleration/deceleration

Data unit : 1 sec
Data range : 0 to 255
Standard setting : 10
When the load inertia is large, the acceleration/deceleration time becomes longer, Thus, set the value accordingly.

0	15	15*i*	16*i*/16	
6583 6723	3083 3223	3083	4083	Motor voltage setting on normal rotation
6584 6724	3084 3224	3084	4084	Motor voltaage setting on orientation
6585 6725	3085 3225	3085	4085	Motor voltage setting on servo mode(rigid tapping, spindle synchronization)

Data unit : 1%
Data range : 0 to 100
Standard setting : Depends on the motor model
Usually, set the standard value for each motor model.

0	15	15*i*	16*i*/16	
6587 6727	3087 3227	3087	4087	The alarm level of the difference between the estimated speed and the motor speed calculated from the position coder signal (9D12 series only)

Data unit : min^{-1}

Data range : 0 to 32767

Standard setting : 0 (But, in the control software, initial alarm level is 100 (min^{-1}))

This parameter is used to detect AL–35. This alarm happens when the difference between the estimated speed and the motor speed calculated from the position coder signal exceeds this parameter setting value and this condition continues more than 1sec. When AL–35 is occurred, please check the gear ratio parameter, or the position coder mounting direction parameter, or gear/clutch signal (CTH1,CTH2).

0	15	15*i*	16*i*/16	
6588 6728	3088 3228	3088	4088	Velocity error excess detecting level on motor shaft lock condition

Data unit : 0.01%

Data range : 0 to 10000

Standard setting : 75

This data is used to set the velocity error (=commaned speed – estimated speed) excess detection level on motor shaft lock condition. When the motor is locked and the velocity error exceeds the value of (maximum speed) × (setting data) /10000, (AL–31) occurs.

0	15	15*i*	16*i*/16	
6589 6729	3089 3229	3089	4089	Velocity error excess detecting level on motor rotation

Data unit : 0.1%

Data range : 0 to 1000

Standard setting : 200

This data is used to set the velocity error (=commaned speed – estimated speed) excess detection level on motor rotation. When the velocity error exceeds the value of (maximum speed) × (setting data) /1000, (AL–02) occurs.

0	15	15*i*	16*i*/16	
6590 6730	3090 3230	3090	4090	Overload detecting level

Data unit : 1%

Data range : 0 to 100

Standard setting : 90

When the motor load remains to be equal to or more than the value of “maximum power” × (setting data) for a long time (this time is set PRM4123:Series16), the short–time overload alarm (AL–29) occurs.

0	15	15*i*	16*i*/16	
6592 6732	3092 3232	3092	4092	Spindle orientation deceleration constant (HIGH) CTH1 = 0, CTH2 = 0
6593 6733	3093 3233	3093	4093	Spindle orientation deceleration constant (MEDIUM HIGH) CTH1 = 0, CTH2 = 1
6594 6734	3094 3234	3094	4094	Spindle orientation deceleration constant (MEDIUM LOW) CTH1 = 1, CTH2 = 0
6595 6735	3095 3235	3095	4095	Spindle orientation deceleration constant (LOW) CTH1 = 1, CTH2 = 1

Data unit : –
Data range : 0 to 32767
Standard setting : 250

These parameters set the deceleration constant for the position coder method spindle orientation. The value to be set can be calculated the following formula.

$$\text{Spindle orientation deceleration constant} = \sqrt{120 \times (\text{Acc/Dec time constant}) \times 0.8}$$

Acc/Dec time constant (min^{-1}/sec) is the setting data of PRM4069 to 4072 (Series 16).

0	15	15*i*	16*i*/16	
6596 6736	3096 3236	3096	4096	Adjustment of SM terminal output voltage

Data unit : 0.1%
Data range : –1000 to +100
Standard setting : 0

This parameter is set when carrying out minute adjustment of SM terminal output voltage. Output voltage becomes large in +data.

0	15	15*i*	16*i*/16	
6597 6737	3097 3237	3097	4097	Delay time for motor excitation (9D12 series only)

Data unit : 1msec
Data range : 0 to 32767
Standard setting : 0

This parameter for setting time until motor excitation is stable in rigid tapping.

0	15	15*i*	16*i*/16	
6598 6738	3098 3238	3098	4098	Maximum speed of position coder signal detection

Data unit : 1 min^{-1}
Data range : 0 to 32767
Standard setting : 0

This parameter for setting the maximum speed of position coder signal detection possible. if the parameter is set to “0”, the speed of detection possible is the same as the maximum speed for the motor.

0	15	15*i*	16*i*/16	
6599 6739	3099 3239	3099	4099	Q axis voltage clamp value (valid in 9D11/H and 9D12/A, or later)

0	15	15*i*	16*i*/16	
6600 6740	3100 3240	3100	4100	Magnetic flux down start speed

0	15	15*i*	16*i*/16	
6601 6741	3101 3241	3101	4101	Base speed of motor power specification

0	15	15*i*	16*i*/16	
6602 6742	3102 3242	3102	4102	R1 compensation constant

0	15	15*i*	16*i*/16	
6603 6743	3103 3243	3103	4103	ID compensation constant

0	15	15*i*	16*i*/16	
6604 6744	3104 3244	3104	4104	VQ side R1 compensation gain

0	15	15*i*	16*i*/16	
6605 6745	3105 3245	3105	4105	Current loop proportional gain

0	15	15*i*	16*i*/16	
6606 6746	3106 3246	3106	4106	Current loop integral gain

0	15	15*i*	16*i*/16	
6607 6747	3107 3247	3107	4107	IDERR clamp level

0	15	15*i*	16*i*/16	
6608 6748	3108 3248	3108	4108	IQCERR clamp slope

0	15	15*i*	16*i*/16	
6609 6749	3109 3249	3109	4109	ID compensation constant in low speed area (valid in 9D11/L or later)

0	15	15*i*	16*i*/16	
6610 6750	3110 3250	3110	4110	Current conversion constant

0	15	15*i*	16*i*/16	
6611 6751	3111 3251	3111	4111	Kd clamp value

0	15	15*i*	16*i*/16	
6612 6752	3112 3252	3112	4112	Leakage inductance compensation speed limit

0	15	15*i*	16*i*/16	
6613 6753	3113 3253	3113	4113	Slip constant

0	15	15*i*	16*i*/16	
6614 6754	3114 3254	3114	4114	Dead band compensation zero speed

0	15	15*i*	16*i*/16	
6615 6755	3115 3255	3115	4115	Current detection phase compensation coefficient

0	15	15*i*	16*i*/16	
6616 6756	3116 3256	3116	4116	Electromotive voltage compensation coefficient

0	15	15*i*	16*i*/16	
6617 6757	3117 3257	3117	4117	Dead band hysterisis 1

0	15	15*i*	16*i*/16	
6618 6758	3118 3258	3118	4118	Dead band hysterisis 2

0	15	15*i*	16*i*/16	
6619 6759	3119 3259	3119	4119	Dead band hysterisis compensation speed

0	15	15*i*	16*i*/16	
6620 6760	3120 3260	3120	4120	Dead time compensation data

0	15	15*i*	16*i*/16	
6621 6761	3121 3261	3121	4121	IQ filter time constant

0	15	15*i*	16*i*/16	
6622 6762	3122 3262	3122	4122	IQS filter time constant (for slip compensation)

0	15	15*i*	16*i*/16	
6623 6763	3123 3263	3123	4123	Over load detecting time

0	15	15*i*	16*i*/16	
6624 6764	3124 3264	3124	4124	IQC filter time constant

0	15	15*i*	16*i*/16	
6625 6765	3125 3265	3125	4125	Timer setting for automatic operation (valid in 9D11/O and 9D12 /A, or later)

0	15	15*i*	16*i*/16	
6626 6766	3126 3266	3126	4126	Velocity command on automatic operation (valid in 9D11/O and 9D12/A, or later)

0	15	15*i*	16*i*/16	
6627 6767	3127 3267	3127	4127	Load meter display value on maximum power

0	15	15*i*	16*i*/16	
6629 6769	3129 3269	3129	4129	IDCMD filter time constant

0	15	15*i*	16*i*/16	
6630 6770	3130 3270	3130	4130	IQ compensation constant

0	15	15*i*	16*i*/16	
6631 6771	3131 3271	3131	4131	Leakage inductance compensation

0	15	15*i*	16*i*/16	
6632 6772	3132 3272	3132	4132	Load meter data for output

0	15	15*i*	16*i*/16	
6633 6773	3133 3273	3133	4133	Motor model code

Data unit : –

Data range : 220 or later

- If the motor model code is set to less than "219", the parameter miss setting alarm (AL–34) is occurred. Because the parameter of ROM version 9D10 is not used at the ROM version 9D12.
- Please perform the automatic parameter setting for 9D12 by using the motor model code more than "220".

0	15	15*i*	16*i*/16	
6300 6480	3480 3700	3336	4336	Magnetic flux switching point used for calculating Acc/Dec time constant on spindle synchronization control

Data unit : 1 min^{-1}

Data range : 0 to 32767

Standard setting : 0

In the area below the speed set in this parameter, acceleration/deceleration is performed according to the time constant set in parameter No.4032 (Acceleration/Deceleration time constant on spindle synchronization control (Series FS16)). In the area above the speed set in this parameter, the time constant varies according to the torque characteristic. When "0" is set in this parameter, the linear acceleration/deceleration is performed. Please set the same value in this parameter for 1st spindle and 2nd spindle.

0	15	15*i*	16*i*/16	
6304 6484	3484 3704	3340	4340	Bell type acceleration/deceleration time constant on spindle synchronization (9D12 series only)

Data unit : msec

Data range : 0 to 512

Standard setting : 0

At the start and end of the linear acceleration/deceleration in spindle synchronization control, this parameter is effective to reduce the synchronization error. When "0" is set in this parameter, the linear acceleration/deceleration is performed. Please set the same value in this parameter for 1st spindle and 2nd spindle.

4 PARAMETER LIST IN EACH MODE

Spindle motor α C series parameter table for each model for 9D11 and 9D12 (No.1)

Model code				220	221	222	223	224	225
Parameter No.				α C1 1.5/2.2 kW 3000/6000 min^{-1}	α C1.5 1.1/3.7 kW 1500/6000 min^{-1}	α C2 2.2/3.7 kW 1500/6000 min^{-1}	α C3 3.7/5.5 kW 1500/6000 min^{-1}	α C6 5.5/7.5 kW 1500/6000 min^{-1}	α C8 7.5/11 kW 1500/6000 min^{-1}
0	15	15*i*	16*i*/16						
6511	3011	3011	4011	0000 1000	0000 1000	0000 1000	0000 1000	0000 1000	0000 1000
6513	3013	3013	4013	0000 1100	0000 1100	0000 1100	0000 1100	0000 1100	0000 1100
6520	3020	3020	4020	6000	6000	6000	6000	6000	6000
6540 to 6541	3040 to 3041	3040 to 3041	4040 to 4041	90*	60*	60*	90*	75*	60*
6542 to 6545	3042 to 3045	3042 to 3045	4042 to 4045	150*	100*	100*	150*	125*	100*
6548 to 6549	3048 to 3049	3048 to 3049	4048 to 4049	360*	240*	240*	360*	300*	240*
6550 to 6553	3050 to 3053	3050 to 3053	4050 to 4053	600*	400*	400*	600*	500*	400*
6580	3080	3080	4080	100	100	100	100	100	100
6583	3083	3083	4083	60	60	60	60	60	60
6584	3084	3084	4084	60*	60*	60*	60*	60*	60*
6585	3085	3085	4085	60*	60*	60*	60*	60*	60*
6600	3100	3100	4100	3000	2000	2038	1550	1730	1500
6601	3101	3101	4101	3000	1500	1700	1500	1700	1500
6602	3102	3102	4102	74	90	71	70	60	72
6603	3103	3103	4103	200	200	200	200	400	200
6604	3104	3104	4104	0	700	700	700	700	700
6605	3105	3105	4105	1300	1200	500	800	400	500
6606	3106	3106	4106	120	60	50	50	20	20
6607	3107	3107	4107	1024	1024	1024	1024	1024	1024
6608	3108	3108	4108	64	64	64	128	128	128
6610	3110	3110	4110	726	435	581	484	726	580
6611	3111	3111	4111	1000	1000	1000	1000	100	1000
6612	3112	3112	4112	6000	6000	6000	6000	5000	6000
6613	3113	3113	4113	400	500	180	160	130*	120*
6615	3115	3115	4115	5000	0	0	0	0	0

Model code				220	221	222	223	224	225
Parameter No.				α C1 1.5/2.2 kW 3000/6000 min^{-1}	α C1.5 1.1/3.7 kW 1500/6000 min^{-1}	α C2 2.2/3.7 kW 1500/6000 min^{-1}	α C3 3.7/5.5 kW 1500/6000 min^{-1}	α C6 5.5/7.5 kW 1500/6000 min^{-1}	α C8 7.5/11 kW 1500/6000 min^{-1}
0	15	15*i*	16*i*/16						
6616	3116	3116	4116	168	160	150	159	158	150
6617	3117	3117	4117	200	230	200	200	200	230
6618	3118	3118	4118	20	20	50	50	50	40
6619	3119	3119	4119	3000	2000	1500	1500	1500	1500
6620	3120	3120	4120	15	15	15	15	15	15
6621	3121	3121	4121	5	5	5	5	5	5
6622	3122	3122	4122	20	20	20	20	20	20
6624	3124	3124	4124	2	2	2	2	2	2
6627	3127	3127	4127	176	403	178	178	178	178
6629	3129	3129	4129	10	30	30	30	30	30
6630	3130	3130	4130	200	200	200	200	250*	200*
6631	3131	3131	4131	500	400	300	400	200*	300
6632	3132	3132	4132	1000	1212	1900	1700	1750	1950
6633	3133	3133	4133	220	221	222	223	224	225
Amplifier Model				SPMC–2.2	SPMC–5.5	SPMC–5.5	SPMC–5.5	SPMC–11	SPMC–11
Software version				9D12/A	9D12/A	9D12/A	9D12/A	9D12/A	9D12/A

NOTE

In the Series 9D12/A, change value of the parameter with “*” after automatic setting.

Spindle motor αC series parameter table for each model for 9D11 and 9D12 (No.2)

Model code				226	227	228	229	230	
Parameter No.				α C12 11/15 kW 1500/6000 min^{-1}	α C15 15/18.5 kW 1500/6000 min^{-1}	α C18 18.5/22 kW 1500/4500 min^{-1}	α C22 22/26kW 1500/4500 min^{-1}	α C3 spec 4.4/7.5 kW 1500/6000 min^{-1}	
0	15	15*i*	16*i*/16						
6511	3011	3011	4011	0000 1000	0000 1000	0000 1000	0000 1000	0000 1000	
6513	3013	3013	4013	0001 1000	0001 0010	0001 0010	0001 0010	0000 1100	
6520	3020	3020	4020	6000	6000	4500	4500	6000	
6540 to 6541	3040 to 3041	3040 to 3041	4040 to 4041	150*	120*	150*	120*	75*	
6542 to 6545	3042 to 3045	3042 to 3045	4042 to 4045	250*	200*	250*	200*	125*	
6548 to 6549	3048 to 3049	3048 to 3049	4048 to 4049	600*	480*	600*	480*	300*	
6550 to 6553	3050 to 3053	3050 to 3053	4050 to 4053	1000*	800*	1000*	800*	500*	
6580	3080	3080	4080	100	100	100	100	100	
6583	3083	3083	4083	60	60	60	60	60	
6584	3084	3084	4084	60*	60*	60*	60*	60*	
6585	3085	3085	4085	60*	60*	60*	60*	60*	
6600	3100	3100	4100	1500	1600	1600	1500	1700	
6601	3101	3101	4101	1500	1600	1600	1500	1700	
6602	3102	3102	4102	67	40	42	38	80	
6603	3103	3103	4103	200	200	300	200	200	
6604	3104	3104	4104	700	700	700	700	700	
6605	3105	3105	4105	400	500	400	500	500	
6606	3106	3106	4106	20	20	10	20	30	
6607	3107	3107	4107	1024	1024	1024	1024	1024	
6608	3108	3108	4108	128	128	128	128	128	
6610	3110	3110	4110	1005	996	711	1067	830	
6611	3111	3111	4111	1000	1000	1000	1000	1000	
6612	3112	3112	4112	6000	6000	6000	6000	6000	
6613	3113	3113	4113	50	50	50	55	140	
6615	3115	3115	4115	0	0	0	0	0	
6616	3116	3116	4116	160	160	160	165	169	
6617	3117	3117	4117	230	230	300	250	200	
6618	3118	3118	4118	20	20	80	80	50	
6619	3119	3119	4119	1500	1600	1600	1500	1500	

Model code				226	227	228	229	230	
Parameter No.				**α C12 11/15 kW 1500/6000 min^{-1}**	**α C15 15/18.5 kW 1500/6000 min^{-1}**	**α C18 18.5/22 kW 1500/4500 min^{-1}**	**α C22 22/26kW 1500/4500 min^{-1}**	**α C3 spec 4.4/7.5 kW 1500/6000 min^{-1}**	
0	**15**	**15*i***	**16*i*/16**						
6620	3120	3120	4120	55	50	50	50	15	
6621	3121	3121	4121	10	10	10	10	5	
6622	3122	3122	4122	20	20	20	20	20	
6624	3124	3124	4124	5	5	10	5	2	
6627	3127	3127	4127	164	148	143	143	204	
6629	3129	3129	4129	30	30	100	50	30	
6630	3130	3130	4130	150	200	150	200	200	
6631	3131	3131	4131	250	250	200	200	300	
6632	3132	3132	4132	2850	2750	2300	2700	1780	
6633	3133	3133	4133	226	227	228	229	230	
Amplifier Model				SPMC–15	SPMC–22	SPMC–22	SPMC–26	SPMC–11	
Software version				9D12/A	9D12/A	9D12/A	9D12/A	9D12/A	

NOTE

In the Series 9D12/A, change value of the parameter with "*" after automatic setting.

APPENDIX

A SPINDLE PARAMETER TABLE

Spindle parameters are classified into the following types:

A : Parameters related to the setup of detectors
B : Parameters related to the setup of various functions (operating modes)
C : Unique parameters for the drive of spindle motors
D : Parameters related to the setting of alarm detection conditions

A.1 PARAMETERS FOR STANDARD MOTORS (PARAMETERS FOR HIGH–SPEED CHARACTERISTICS, SPINDLE SWITCHING MAIN SIDE)

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6500#0	6640#0	3000#0	3140#0	3000#0	4000#0	0	Spindle and motor rotation direction	○	○			A	000#8
6500#1	6640#1	3000#1	3140#1	3000#1	4000#1	0	Move command and spindle rotation direction in Cs contour control mode	○	○			B	000#9
6500#2	6640#2	3000#2	3140#2	3000#2	4000#2	0	Position coder mounting direction	○	○			A	000#10
6500#3	6640#3	3000#3	3140#3	3000#3	4000#3	0	Return direction for the reference position in Cs contour control mode	○	○			B	000#11
6500#4	6640#4	3000#4	3140#4	3000#4	4000#4	0	Return direction for the reference position in servo mode	○	○			B	000#12
6500#5	6640#5	3000#5	3140#5	3000#5	4000#5	0	Differential speed mode function	○	○			B	000#13
6500#6	6640#6	3000#6	3140#6	3000#6	4000#6	0	Setting of differential speed direction	○	○			A	000#14
6500#7	6400#7	3000#7	3140#7	3000#7	4000#7	0	Number of signal pulses of the remote position coder in differential speed mode	○	○			A	000#15
6501#0	6641#0	3001#0	3141#0	3001#0	4001#0	1	Whether to use MRDY (machine ready) signal	○	○			B	000#0
6501#1	6641#1	3001#1	3141#1	3001#1	4001#1	0							000#1
6501#2	6641#2	3001#2	3141#2	3001#2	4001#2	0	Whether to use the position coder signal	○	○			A	000#2
6501#3	6641#3	3001#3	3141#3	3001#3	4001#3	0	Mounting direction of the magnetic sensor	○	○			A	000#3
6501#4	6641#4	3001#4	3141#4	3001#4	4001#4	0							000#4

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6501#5	6641#5	3001#5	3141#5	3001#5	4001#5	0	Whether to use high–resolution magnetic pulse coder	○	○			A	000#5
6501#6	6641#6	3001#6	3141#6	3001#6	4001#6	0	Setting of speed detection signal when using the high–resolution magnetic pulse coder	○	○			A	000#6
6501#7	6641#7	3001#7	3141#7	3001#7	4001#7	0	Mounting direction of the high–resolution magnetic pulse coder	○	○			A	000#7
6502 #2,1,0	6642 #2,1,0	3002 #2,1,0	3142 #2,1,0	3002 #2,1,0	4002 #2,1,0	0,0,0	Setting of resolution in Cs contour control mode	○	○			A	001#10, 9,8
6502#3	6642#3	3002#3	3142#3	3002#3	4002#3	0							001#11
6502#4	6642#4	3002#4	3142#4	3002#4	4002#4	0	Rotation direction signal function in Cs contour control mode	○	○			B	001#12
6502#5	6642#5	3002#5	3142#5	3002#5	4002#5	0	Rotation direction signal function in servo mode	○	○			B	001#13
6502#6	6642#6	3002#6	3142#6	3002#6	4002#6	0	Rotation direction signal function during synchronization control	○	○			B	001#14
6502#7	6642#7	3002#7	3142#7	3002#7	4002#7	0	CMR function in servo mode	○	○			B	001#15
6503#0	6643#0	3003#0	3143#0	3003#0	4003#0	0	Selection of orientation by position coder or by magnetic sensor	○	○			B	001#0
6503#1	6643#1	3003#1	3143#1	3003#1	4003#1	0	Whether to use MZ sensor (sensor incorporated in a motor)	○	○			A	001#1
#3,2	#3,2	#3,2	#3,2	#3,2	#3,2	0,0	Rotation direction during spindle orientation	○	○			A	#3,2
#7,6,5, 4	#7,6,5, 4	#7,6,5, 4	#7,6,5, 4	#7,6,5, 4	#7,6,5, 4	0,0,0,0	Setting of the position coder signal	○	○			A	#7,6,5,4
6504#0	6644#0	3004#0	3144#0	3004#0	4004#0	0	Whether to use the high–resolution position coder	○	○			A	002#8
6504#1	6644#1	3004#1	3144#1	3004#1	4004#1	0	Whether to use BZ sensor (separate built–in sensor)	○	○			A	002#9
6504#2	6644#2	3004#2	3144#2	3004#2	4004#2	0	Whether to use external one–rotation signal	○	○			A	002#10
6504#3	6644#3	3004#3	3144#3	3004#3	4004#3	0	Setting of external one–rotation signal detection edge	○	○			A	002#11
6504#4	6644#4	3004#4	3144#4	3004#4	4004#4	0	Setup of MZ sensor (sensor incorporated in a motor)	○	○			A	002#12
6504#5	6644#5	3004#5	3144#5	3004#5	4004#5	0							002#13
6504#6	6644#6	3004#6	3144#6	3004#6	4004#6	0							002#14
6504#7	6644#7	3004#7	3144#7	3004#7	4004#7	0							002#15
6505#0	6645#0	3005#0	3145#0	3005#0	4005#0	0							002#0
6505#1	6645#1	3005#1	3145#1	3005#1	4005#1	0							002#1
6505#2	6645#2	3005#2	3145#2	3005#2	4005#2	0							002#2
6505#3	6645#3	3005#3	3145#3	3005#3	4005#3	0							002#3
6505#4	6645#4	3005#4	3145#4	3005#4	4005#4	0							002#4
6505#5	6645#5	3005#5	3145#5	3005#5	4005#5	0							002#5
6505#6	6645#6	3005#6	3145#6	3005#6	4005#6	0							002#6
6505#7	6645#7	3005#7	3145#7	3005#7	4006#7	0							002#7

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6506#0	6646#0	3006#0	3146#0	3006#0	4006#0	0							003#8
6506#1	6646#1	3006#1	3146#1	3006#1	4006#1	0	Setting of gear ratio resolution	○	○			B	003#9
6506#2	6646#2	3006#2	3146#2	3006#2	4006#2	0	Setting in 10–min^{-1} units	○	○			C	003#10
6506#3	6646#3	3006#3	3146#3	3006#3	4006#3	0	Automatic detection of one–rotation signal during spindle synchronization	○	○			B	003#11
6506#4	6646#4	3006#4	3146#4	3006#4	4006#4	0							003#12
6506#5	6646#5	3006#5	3146#5	3006#5	4006#5	0	Setting of analog override range	○	○			B	003#13
6506#6	6646#6	3006#6	3146#6	3006#6	4006#6	0							003#14
6506#7	6646#7	3006#7	3146#7	3006#7	4006#7	0	Setup of rigid tapping with MZ sensor (built–in sensor with built–in motor)	○	○			B	003#15
6507#0	6647#0	3007#0	3147#0	3007#0	4007#0	0							003#0
6507#1	6647#1	3007#1	3147#1	3007#1	4007#1	0							003#1
6507#2	6647#2	3007#2	3147#2	3007#2	4007#2	0							003#2
6507#3	6647#3	3007#3	3147#3	3007#3	4007#3	0							003#3
6507#4	6647#4	3007#4	3147#4	3007#4	4007#4	0							003#4
6507#5	6647#5	3007#5	3147#5	3007#5	4007#5	0	Whether to detect disconnection of the high–resolution magnetic pulse coder/position coder	○	○			D	003#5
6507#6	6647#6	3007#6	3147#6	3007#6	4007#6	0	Whether to detect alarms (AL–41, 42, and 47) related to the position coder signal	○	○			D	003#6
6507#7	6647#7	3007#7	3147#7	3007#7	4007#7	Depends on the model	Conventional: Setting of motor voltage pattern at no load HRV:	○	○			C	003#7
6508#0	6648#0	3008#0	3148#0	3008#0	4008#0	Depends on the model	Setup of electromotive force compensation (high–speed winding)	○				C	004#8
6508#1	6648#1	3008#1	3148#1	3008#1	4008#1	Depends on the model	Setup of electromotive force compensation (low–speed winding)		○			C	004#9
6508#2	6648#2	3008#2	3148#2	3008#2	4008#2	0							004#10
6508#3	6648#3	3008#3	3148#3	3008#3	4008#3	0							004#11
6508#4	6648#4	3008#4	3148#4	3008#4	4008#4	0							004#12
6508#5	6648#5	3008#5	3148#5	3008#5	4008#5	0							004#13
6508#6	6648#6	3008#6	3148#6	3008#6	4008#6	0							004#14
6508#7	6648#7	3008#7	3148#7	3008#7	4008#7	0							004#15
6509#0	6649#0	3009#0	3149#0	3009#0	4009#0	0	Setting of units of velocity loop gain	○	○			B	004#0
6509#1	6649#1	3009#1	3149#1	3009#1	4009#1	0	Setup of velocity command and velocity feedback reverse during slave operation	○	○			B	004#1
6509#2	6649#2	3009#2	3149#2	3009#2	4009#2	0	Method of cutting off motor power when AL–24 occurs	○	○			D	004#2
6509#3	6649#3	3009#3	3149#3	3009#3	4009#3	0	Arbitrary gear ratio between a spindle and the position coder	○	○			B	004#3

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6509#4	6649#4	3009#4	3149#4	3009#4	4009#4	0	Setting of load detection signal output condition	○	○			B	004#4
6509#5	6649#5	3009#5	3149#5	3009#5	4009#5	Depends on the model	Conventional: Setting of output compensation method	○	○			C	004#5
							HRV:						
6509#6	6649#6	3009#6	3149#6	3009#6	4009#6	0	Analog override type	○	○			B	004#6
6509#7	6649#7	3009#7	3149#7	3009#7	4009#7	0							004#7
6510#0	6650#0	3010#0	3150#0	3010#0	4010#0	0							005#8
6510#1	6650#1	3010#1	3150#1	3010#1	4010#1	0							005#9
6510#2	6650#2	3010#2	3150#2	3010#2	4010#2	0							005#10
6510#3	6650#3	3010#3	3150#3	3010#3	4010#3	0							005#11
6510#4	6650#4	3010#4	3150#4	3010#4	4010#4	0							005#12
6510#5	6650#5	3010#5	3150#5	3010#5	4010#5	0							005#13
6510#6	6650#6	3010#6	3150#6	3010#6	4010#6	0							005#14
6510#7	6650#7	3010#7	3150#7	3010#7	4010#7	0							005#15
6511#2, 1,0	6651#2, 1,0	3011#2, 1,0	3151#2, 1,0	3011#2, 10	4011#2, 10	Depends on the model	Setup of velocity detector	○	○			A	005#2,1, 0
6511#7, 3	6651#7, 3	3011#7, 3	3151#7, 3	3011#7, 3	4011#7, 3	Depends on the model	Number of motor poles	○	○			C	005#7,3
6511#4	6651#4	3011#4	3151#4	3011#4	4011#4	Depends on the model	Setting of maximum output during acceleration/deceleration	○	○			C	005#4
6511#5	6651#5	3011#5	3151#5	3011#5	4011#5	Depends on the model	Conventional: Condition for deciding acceleration/deceleration during maximum output acceleration/deceleration	○	○			C	005#5
							HRV:						
6511#6	6651#6	3011#6	3151#6	3011#6	4011#6	0							005#6
6512#1, 0	6652#1, 0	3012#1, 0	3152#1, 0	3012#1, 0	4012#1, 0	Depends on the model	Setting of PWM carrier frequency	○	○			C	006#9,8
6512#2	6652#2	3012#2	3152#2	3012#2	4012#2	0							006#10
6512#3	6652#3	3012#3	3152#3	3012#3	4012#3	0							006#11
6512#4	6652#4	3012#4	3152#4	3012#4	4012#4	0							006#12
6512#5	6652#5	3012#5	3152#5	3012#5	4012#5	0							006#13
6512#6	6652#6	3012#6	3152#6	3012#6	4012#6	0							006#14
6512#7	6652#7	3012#7	3152#7	3012#7	4012#7	0							006#15
6513#0	6653#0	3013#0	3153#0	3013#0	4013#0	0	Setting of a position coder one–rotation signal detection edge	○	○			A	006#0
6513#1	6653#1	3013#1	3153#1	3013#1	4013#1	1	Setting of a one–rotation signal detection edge for Cs contour control					A	006#1
6513#6, 5,4,3,2	6653#6, 5,4,3,2	3013#6, 5,4,3,2	3153#6, 5,4,3,2	3013#6, 5,4,3,2	4013#6, 5,4,3,2	Depends on the model	Current dead zone data	○	○			C	006#6,5, 4,3,2
6513#7	6653#7	3013#7	3153#7	3013#7	4013#7	Depends on the model	PWM frequency of output switching low–speed winding	○	○			C	006#7
6514#0	6654#0	3014#0	3154#0	3014#0	4014#0	0	Whether to use the spindle switching function	○	○	○	○	B	007#8

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6514#1	6654#1	3014#1	3154#1	3014#1	4014#1	0	Whether to use the spindle switching function during SUB spindle rotation	○	○	○	○	B	007#9
6514#2	6654#2	3014#2	3154#2	3014#2	4014#2	0	Confirmation of MCC of both MAIN and SUB of spindle switching	○	○	○	○	B	007#10
6514#3	6654#3	3014#3	3154#3	3014#3	4014#3	0	Confirmation of MCC of both HIGH and LOW of output switching	○	○	○	○	B	007#11
6514#4	6654#4	3014#4	3154#4	3014#4	4014#4	0	Whether to use the function for orientation by both the position coder and the magnetic sensor	○	○	○	○	B	007#12
6514#5	6654#5	3014#5	3154#5	3014#5	4014#5	0	Whether to use the slave operation function	○	○	○	○	B	007#13
6514#6	6654#6	3014#6	3154#6	3014#6	4014#6	0	Whether to use the orientation function during spindle synchronization	○	○	○	○	B	007#14
6514#7	6654#7	3014#7	3154#7	3014#7	4014#7	0							007#15
6515#0	6655#0	3015#0	3155#0	3015#0	4015#0	0	Whether to use the spindle orientation function	○	○	○	○	B	007#0
6515#1	6655#1	3015#1	3155#1	3015#1	4015#1	0	Whether to use the spindle load monitor function	○	○	○	○	B	007#1
6515#2	6655#2	3015#2	3155#2	3015#2	4015#2	0	Whether to use the output switching function	○	○	○	○	B	007#2
6515#3	6655#3	3015#3	3155#3	3015#3	4015#3	0							007#3
6515#4	6655#4	3015#4	3155#4	3015#4	4015#4	0							007#4
6515#5	6655#5	3015#5	3155#5	3015#5	4015#5	0							007#5
6515#6	6655#6	3015#6	3155#6	3015#6	4015#6	0							007#6
6515#7	6655#7	3015#7	3155#7	3015#7	4015#7	0							007#7
6516#0	6656#0	3016#0	3156#0	3016#0	4016#0	0							008#8
6516#1	6656#1	3016#1	3156#1	3016#1	4016#1	0							008#9
6516#2	6656#2	3016#2	3156#2	3016#2	4016#2	0							008#10
6516#3	6656#3	3016#3	3156#3	3016#3	4016#3	0	Whether to use the smoothing function during feed–forward control	○	○			B	008#11
6516#4	6656#4	3016#4	3156#4	3016#4	4016#4	0	Setting of control characteristics in Cs contour control mode	○	○			B	008#12
6516#5	6656#5	3016#5	3156#5	3016#5	4016#5	0	Whether to use one–rotation signal misdetection (AL–39) function of detector for Cs contour control	○	○			B	008#13
6516#6	6656#6	3016#6	3156#6	3016#6	4016#6	0	Whether to use a one–rotation signal misdetection (AL–46) function of the position coder signal	○	○			B	008#14
6516#7	6656#7	3016#7	3156#7	3016#7	4016#7	0	Setting of the one–rotation signal detection condition	○	○			B	008#15
6517#0	6657#0	3017#0	3157#0	3017#0	4017#0	0							008#0
6517#1	6657#1	3017#1	3157#1	3017#1	4017#1	0							008#1

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6517#2	6657#2	3017#2	3157#2	3017#2	4017#2	0	Whether to use the position coder one–rotation signal detection function during normal rotation	○	○			B	008#2
6517#3	6657#3	3017#3	3157#3	3017#3	4017#3	0	Whether to use the position coder one–rotation signal detection function during orientation by magnetic sensor	○	○			B	008#3
6517#4	6657#4	3017#4	3157#4	3017#4	4017#4	0							008#4
6517#5	6657#5	3017#5	3157#5	3017#5	4017#5	0							008#5
6517#6	6657#6	3017#6	3157#6	3017#6	4017#6	0							008#6
6517#7	6657#7	3017#7	3157#7	3017#7	4017#7	0	Whether to use the short–cut function during orientation from stopped state	○	○			B	008#7
6518#0	6658#0	3018#0	3158#0	3018#0	4018#0	0							009#8
6518#1	6658#1	3018#1	3158#1	3018#1	4018#1	0							009#9
6518#2	6658#2	3018#2	3158#2	3018#2	4018#2	0							009#10
6518#3	6658#3	3018#3	3158#3	3018#3	4018#3	0							009#11
6518#4	6658#4	3018#4	3158#4	3018#4	4018#4	0	Whether to use the α sensor Cs contour control function	○	○			B	009#12
6518#5	6658#5	3018#5	3158#5	3018#5	4018#5	0	Whether to use the velocity command compensation function during high–speed orientation	○	○			B	009#13
6518#6	6658#6	3018#6	3158#6	3018#6	4018#6	0	Whether to use the high–speed orientation function	○	○			B	009#14
6518#7	6658#7	3018#7	3158#7	3018#7	4018#7	0							009#15
6519#0	6659#0	3019#0	3159#0	3019#0	4019#0	0	Conventional: Whether to compensate dead zone in Cs contour control mode and during orientation HRV:	○	○			B	009#0
6519#1	6659#1	3019#1	3159#1	3019#1	4019#1	0							009#1
6519#2	6659#2	3019#2	3159#2	3019#2	4019#2	1	Whether to use torque clamp at zero speed	○	○			C	009#2
6519#3	6659#3	3019#3	3159#3	3019#3	4019#3	0							009#3
6519#4	6659#4	3019#4	3159#4	3019#4	4019#4	0	Setting of winding switching condition during output switching	○	○			B	009#4
6519#5	6659#5	3019#5	3159#5	3019#5	4019#5	0	Conventional: Setup of the DC link voltage detection filter HRV:	○	○			B	009#5
6519#6	6659#6	3019#6	3159#6	3019#6	4019#6	0							009#6
6519#7	6659#7	3019#7	3159#7	3019#7	4019#7	0	Automatic parameter setting function	○	○			B	009#7

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6520	6660	3020	3160	3020	4020	Depends on the model	Maximum motor speed	○	○			C	010
6521	6661	3021	3161	3021	4021	100	Maximum speed in Cs contour control mode	○	○			B	011
6522	6662	3022	3162	3022	4022	150	Speed arrival detection level	○	○			B	012
6523	6663	3023	3163	3023	4023	30	Speed detection level	○	○			B	013
6524	6664	3024	3164	3024	4024	75	Zero speed detection level	○	○			B	014
6525	6665	3025	3165	3025	4025	50	Limited torque	○	○			B	015
6526	6666	3026	3166	3026	4026	83	Load detection level 1	○	○			B	016
6527	6667	3027	3167	3027	4027	95	Load detection level 2	○	○	○	○	B	017
6528	6668	3028	3168	3028	4028	0	Limited output pattern	○	○			B	018
6529	6669	3029	3169	3029	4029	100	Output limit	○	○			B	019
6530	6670	3030	3170	3030	4030	0	Soft start/stop time	○	○	○	○	B	020
6531	6671	3031	3171	3031	4031	0	Stop position in orientation by position coder	○	○			B	021
6532	6672	3032	3172	3032	4032	0	Acceleration/deceleration time constant during spindle synchronization	○	○			B	022
6533	6673	3033	3173	3033	4033	10	Spindle synchronization speed arrival level	○	○			B	023
6534	6674	3034	3174	3034	4034	0	Shift during synchronous control of spindle phase	○	○			B	024
6535	6675	3035	3175	3035	4035	0	Compensation data for spindle phase synchronization	○	○			B	025
6536	6676	3036	3176	3036	4036	0	Feed–forward factor	○	○			B	026
6537	6677	3037	3177	3037	4037	0	Feed–forward factor of velocity loop	○	○			B	027
6538	6678	3038	3178	3038	4038	0	Spindle orientation speed	○	○			B	028
6539	6679	3039	3179	3039	4039	0	Temperature compensation gain	○				C	029
6540	6680	3040	3180	3040	4040	10	Proportional gain of velocity loop during normal operation (HIGH)	○	○			B	030
6541	6681	3041	3181	3041	4041	10	Proportional gain of velocity loop during normal operation (LOW)	○	○			B	031
6542	6682	3042	3182	3042	4042	10	Proportional gain of velocity loop during orientation (HIGH)	○	○			B	032
6543	6683	3043	3183	3043	4043	10	Proportional gain of velocity loop during orientation (LOW)	○	○			B	033
6544	6684	3044	3184	3044	4044	10	Proportional gain of velocity loop in servo mode (HIGH)	○	○			B	034
6545	6685	3045	3185	3045	4045	10	Proportional gain of velocity loop in servo mode (LOW)	○	○			B	035
6546	6686	3046	3186	3046	4046	30	Proportional gain of velocity loop in Cs contour control mode (HIGH)	○	○			B	036

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6547	6687	3047	3187	3047	4047	30	Proportional gain of velocity loop in Cs contour control mode (LOW)	○	○			B	037
6548	6688	3048	3188	3048	4048	10	Integral gain of velocity loop during normal operation (HIGH)	○	○			B	038
6549	6689	3049	3189	3049	4049	10	Integral gain of velocity loop during normal operation (LOW)	○	○			B	039
6550	6690	3050	3190	3050	4050	10	Integral gain of velocity loop during orientation (HIGH)	○	○			B	040
6551	6691	3051	3191	3051	4051	10	Integral gain of velocity loop during orientation (LOW)	○	○			B	041
6552	6692	3052	3192	3052	4052	10	Integral gain of velocity loop in servo mode (HIGH)	○	○			B	042
6553	6693	3053	3193	3053	4053	10	Integral gain of velocity loop in servo mode (LOW)	○	○			B	043
6554	6694	3054	3194	3054	4054	50	Integral gain of velocity loop in Cs contour control mode (HIGH)	○	○			B	044
6555	6695	3055	3195	3055	4055	50	Integral gain of velocity loop in Cs contour control mode (LOW)	○	○			B	045
6556	6696	3056	3196	3056	4056	100	Gear ratio (HIGH)	○	○			B	046
6557	6697	3057	3197	3057	4057	100	Gear ratio (MEDIUM HIGH)	○	○			B	047
6558	6698	3058	3198	3058	4058	100	Gear ratio (MEDIUM-LOW)	○	○			B	048
6559	6699	3059	3199	3059	4059	100	Gear ratio (LOW)	○	○			B	049
6560	6700	3060	3200	3060	4060	1000	Position gain during orientation (HIGH)	○	○			B	050
6561	6701	3061	3201	3061	4061	1000	Position gain during orientation (MEDIUM HIGH)	○	○			B	051
6562	6702	3062	3202	3062	4062	1000	Position gain during orientation (MEDIUM LOW)	○	○			B	052
6563	6703	3063	3203	3063	4063	1000	Position gain during orientation (LOW)	○	○			B	053
6564	6704	3064	3204	3064	4064	100	Rate of change in position gain upon completion of orientation	○	○			B	054
6565	6705	3065	3205	3065	4065	1000	Position gain in servo mode/during synchronization control (HIGH)	○	○			B	055
6566	6706	3066	3206	3066	4066	1000	Position gain in servo mode/during synchronization control (MEDIUM HIGH)	○	○			B	056
6567	6707	3067	3207	3067	4067	1000	Position gain in servo mode/during synchronization control (MEDIUM LOW)	○	○			B	057
6568	6708	3068	3208	3068	4068	1000	Position gain in servo mode/during synchronization control (LOW)	○	○			B	058
6569	6709	3069	3209	3069	4069	3000	Position gain in Cs contour control mode (HIGH)	○	○			B	059

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application: MAIN high speed	Application: MAIN low speed	Application: SUB high speed	Application: SUB low speed	Classi-fica-tion	Internal data number F–xxx
6570	6710	3070	3210	3070	4070	3000	Position gain in Cs contour control mode (MEDIUM HIGH)	○	○			B	060
6571	6711	3071	3211	3071	4071	3000	Position gain in Cs contour control mode (MEDIUM LOW)	○	○			B	061
6572	6712	3072	3212	3072	4072	3000	Position gain in Cs contour control mode (LOW)	○	○			B	062
6573	6713	3073	3213	3073	4073	0	Grid shift in servo mode	○	○			B	063
6574	6714	3074	3214	3074	4074	0	Reference position return speed in Cs contour control/servo mode	○	○			B	064
6575	6715	3075	3215	3075	4075	10	Detection level for orientation completion signal	○	○			B	065
6576	6716	3076	3216	3076	4076	33	Motor speed limit during orientation	○	○			B	066
6577	6717	3077	3217	3077	4077	0	Orientation stop position shift	○	○			B	067
6578	6718	3078	3218	3078	4078	200	MS signal constant	○	○			B	068
6579	6719	3079	3219	3079	4079	0	MS signal gain adjustment	○	○			B	069
6580	6720	3080	3220	3080	4080	Depends on the model	Conventional: Regenerative power limit HRV: Regenerative power limit for high–speed zone/regenerative power limit	○				C	070
6581	6721	3081	3221	3081	4081	20	Delay time until motor power is cut off	○	○			B	071
6582	6722	3082	3222	3082	4082	10	Setting of acceleration/ deceleration time	○	○			B	072
6583	6723	3083	3223	3083	4083	Depends on the model	Motor voltage during normal rotation	○				B	073
6584	6724	3084	3224	3084	4084	Depends on the model	Motor voltage during orientation	○	○			B	074
6585	6725	3085	3225	3085	4085	Depends on the model	Motor voltage in servo mode/during synchronization control	○				B	075
6586	6726	3086	3226	3086	4086	Depends on the model	Motor voltage in Cs contour control mode	○	○			B	076
6587	6727	3087	3227	3087	4087	115	Overspeed level	○	○	○	○	D	077
6588	6728	3088	3228	3088	4088	75	Level for detecting excess velocity deviation when motor is restrained	○	○	○	○	D	078
6589	6729	3089	3229	3089	4089	200	Level for detecting excess velocity deviation when motor rotates	○	○	○	○	D	079
6590	6730	3090	3230	3090	4090	90	Overload detection level	○	○	○	○	D	080
6591	6731	3091	3231	3091	4091	100	Rate of change in position gain during reference position return in servo mode	○	○			B	081

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i*/16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6592	6732	3092	3232	3092	4092	100	Rate of change in position gain during reference position return in Cs contour control mode	○	○			B	082
6593	6733	3093	3233	3093	4093	Depends on the mode	Value displayed on load meter at maximum output (low–speed winding, FS15*i*, FS16*i*/16 only)		○			C	083
6594	6734	3094	3234	3094	4094	0	Disturbance torque compensation constant	○	○			B	084
6595	6735	3095	3235	3095	4095	0	Adjusted output voltage of speedometer	○	○	○	○	B	085
6596	6736	3096	3236	3096	4096	0	Adjusted output voltage of load meter	○	○	○	○	B	086
6597	6737	3097	3237	3097	4097	0	Feedback gain of spindle speed	○	○			B	087
6598	6738	3098	3238	3098	4098	0	Maximum speed of position coder signal detection	○	○	○	○	B	088
6599	6739	3099	3239	3099	4099	0	Motor activation delay	○	○	○	○	B	089
6600	6740	3100	3240	3100	4100	Depends on the mode	Conventional: Base speed of motor output specifications HRV: Base speed of motor output specifications	○	○			C	090
6601	6741	3101	3241	3101	4101	Depends on the mode	Conventional: Output limit for motor output specifications HRV: Output limit for motor output specifications	○				C	091
6602	6742	3102	3242	3102	4102	Depends on the mode	Conventional: Base speed HRV: Activating voltage saturation speed at no–load	○				C	092
6603	6743	3103	3243	3103	4103	Depends on the mode	Conventional: Speed at which decrease in magnetic flux begins HRV: Base speed limit ratio	○				C	093
6604	6744	3104	3244	3104	4104	Depends on the mode	Conventional: Proportional gain of current loop HRV: Proportional gain of current loop	○				C	094
6605	6745	3105	3245	3105	4105	Depends on the mode	Conventional: Proportional gain of current loop (in Cs contour control mode) HRV:	○				C	095
6606	6746	3106	3246	3106	4106	Depends on the mode	Conventional: Integral gain of current loop HRV: Integral gain of current loop	○				C	096

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6607	6747	3107	3247	3107	4107	Depends on the mode	Conventional: Integral gain of current loop (in Cs contour control mode) HRV:	○				C	097
6608	6748	3108	3248	3108	4108	Depends on the mode	Conventional: Velocity at which the current loop integral gain is zero HRV: Velocity at which the current loop integral gain is zero	○				C	098
6609	6749	3109	3249	3109	4109	Depends on the mode	Conventional: Velocity factor for proportional gain of current loop HRV: Filter time constant for processing saturation related to the voltage command	○				C	099
6610	6750	3110	3250	3110	4110	Depends on the model	Conventional: Current conversion constant HRV: Current conversion constant	○				C	100
6611	6751	3111	3251	3111	4111	Depends on the model	Conventional: Secondary current factor for activating current HRV: Secondary current factor	○				C	101
6612	6752	3112	3252	3112	4112	Depends on the model	Conventional: Expected–current constant HRV: Criterion level for saturation related to the voltage command/PWM command clamp value	○				C	102
6613	6753	3113	3253	3113	4113	Depends on the model	Conventional: Slip constant HRV: Slip constant	○				C	103
6614	6754	3114	3254	3114	4114	Depends on the model	Conventional: Compensation constant for high–speed–rotation slip HRV: Slip compensation coefficient for a high–speed zone/slip compensation coefficient at deceleration	○				C	104
6615	6755	3115	3255	3115	4115	Depends on the model	Conventional: Compensation constant for voltage applied to motor in dead zone HRV: PWM command clamp value at deceleration	○				C	105
6616	6756	3116	3256	3116	4116	Depends on the model	Conventional: Compensation constant for electromotive force HRV: Motor leakage constant	○				C	106

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6617	6757	3117	3257	3117	4117	Depends on the model	Conventional: Compensation constant for phase of electromotive force HRV: Regular–time voltage compensation coefficient for high–speed zone/regular–time motor voltage coefficient	○				C	107
6618	6758	3118	3258	3118	4118	Depends on the model	Conventional: Electromotive force compensation speed factor HRV: Acceleration–time voltage compensation coefficient for high–speed zone/acceleration–time motor voltage coefficient	○				C	108
6619	6759	3119	3259	3119	4119	0	Conventional: Time constant for voltage filter of electromotive force compensation HRV: Deceleration–time activating current change time constant	○				C	109
6620	6760	3120	3260	3120	4120	Depends on the model	Conventional: Dead band compensation data HRV: Rectangular–wave component zero voltage/dead–zone compensation data	○	○	○	○	C	110
6621	6761	3121	3261	3121	4121	5	Time constant for changing the torque	○				B	111
6622	6762	3122	3262	3122	4122	0	Time constant for velocity detecting filter	○	○			B	112
6623	6763	3123	3263	3123	4123	30	Short–time overload detection time	○	○	○	○	D	113
6624	6764	3124	3264	3124	4124	0	Conventional: Voltage compensation factor during deceleration HRV:	○				C	114
6625	6765	3125	3265	3125	4125	0	Timer for automatic operation	○	○	○	○	B	115
6626	6766	3126	3266	3126	4126	0	Velocity command during automatic operation	○	○	○	○	B	116
6627	6767	3127	3267	3127	4127	Depends on the model	Conventional: Value displayed on load meter at maximum output HRV: Value displayed on load meter at maximum output	○	○			C	117
6628	6768	3128	3268	3128	4128	Depends on the model	Conventional: Velocity at which maximum output limit is zero HRV: Maximum torque curve compensation coefficient	○				C	118
6629	6769	3129	3269	3129	4129	Depends on the model	Conventional: Secondary current factor for rigid tapping HRV: Secondary current factor for rigid tapping	○				C	119

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6630	6770	3130	3270	3130	4130	Depends on the model	Conventional: Compensation factor for phase of electromotive force during deceleration HRV: Current loop proportional gain speed coefficient/current phase delay compensation coefficient	○				C	120
6631	6771	3131	3271	3131	4131	0	Time constant for velocity detecting filter (in Cs contour control mode)	○	○			B	121
6632	6772	3132	3272	3132	4132	0	Current conversion constant for V phase	○				C	122
6633	6773	3133	3273	3133	4133	Depends on the model	Motor model code	○	○			C	123
6634	6774	3134	3274	3134	4134	0							124125
6635	6775	3135	3275	3135	4135	0	Grid shift in Cs contour control mode	○	○			B	126127

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
–	–	3716#0	3758#0	3352#0	4352#0	0							336#8
–	–	3716#1	3758#1	3352#1	4352#1	0							336#9
–	–	3716#2	3758#2	3352#2	4352#2	0							336#10
–	–	3716#3	3758#3	3352#3	4352#3	0							336#11
–	–	3716#4	3758#4	3352#4	4352#4	0							336#12
–	–	3716#5	3758#5	3352#5	4352#5	0							336#13
–	–	3716#6	3758#6	3352#6	4352#6	0							336#14
–	–	3716#7	3758#7	3352#7	4352#7	0							336#15
–	–	3717#0	3759#0	3353#0	4353#0	0							336#0
–	–	3717#1	3759#1	3353#1	4353#1	0							336#1
–	–	3717#2	3759#2	3353#2	4353#2	0							336#2
–	–	3717#3	3759#3	3353#3	4353#3	0							336#3
–	–	3717#4	3759#4	3353#4	4353#4	0							336#4
–	–	3717#5	3759#5	3353#5	4353#5	0							336#5
–	–	3717#6	3759#6	3353#6	4353#6	0							336#6
–	–	3717#7	3759#7	3353#7	4353#7	0							336#7
–	–	3718	3760	3354	4354	0							337
–	–	3719	3761	3355	4355	0	MZ sensor signal amplitude ratio compensation (when using the α sensor Cs contour control function)	○	○			A	338
–	–	3720	3762	3356	4356	0	MZ sensor signal phase difference compensation (when using the α sensor Cs contour control function)	○	○			A	339
–	–	3721	3763	3357	4357	0	BZ sensor signal amplitude ratio compensation (when using the α sensor Cs contour control function)	○	○			A	340
–	–	3722	3764	3358	4358	0	BZ sensor signal phase difference compensation (when using the α sensor Cs contour control function)	○	○			A	341
–	–	3723	3765	3359	4359	0							342
–	–	3724	3766	3360	4360	0							343
–	–	3725	3767	3361	4361	0							344
–	–	3726	3768	3362	4362	0							345
–	–	3727	3769	3363	4363	0							346
–	–	3728	3770	3364	4364	0							347
–	–	3729	3771	3365	4365	0							348
–	–	3730	3772	3366	4366	0							349
–	–	3731	3773	3367	4367	0							350
–	–	3732	3774	3368	4368	0							351
–	–	3733	3775	3369	4369	0							352
–	–	3734	3776	3370	4370	0							353
–	–	3735	3777	3371	4371	0							354
–	–	3736	3778	3372	4372	0							355

A.2 PARAMETERS FOR LOW–SPEED CHARACTERISTICS, SPINDLE SWITCHING MAIN SIDE

FS0		FS15		FS15i	FS16i /16	Standard initial setting data	Contents	Application				Classi-fication	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6900	6940	3280	3500	3136	4136	Depends on the model	Motor voltage during normal rotation		○			B	128
6901	6941	3281	3501	3137	4137	Depends on the model	Motor voltage in servo mode/during synchronization control		○			B	129
6902	6942	3282	3502	3138	4138	Depends on the model	Conventional: Base speed of motor output specifications HRV: Base speed of motor output specifications		○			C	130
6903	6943	3283	3503	3139	4139	Depends on the model	Conventional: Output limit for motor output specifications HRV: Output limit for motor output specifications		○			C	131
6904	6944	3284	3504	3140	4140	Depends on the model	Conventional: Base speed HRV: Activating voltage saturation speed at no–load		○			C	132
6905	6945	3285	3505	3141	4141	Depends on the model	Conventional: Speed at which decrease in magnetic flux begins HRV: Base speed limit ratio		○			C	133
6906	6946	3286	3506	3142	4142	Depends on the model	Conventional: Proportional gain of current loop HRV: Proportional gain of current loop		○			C	134
6907	6947	3287	3507	3143	4143	Depends on the model	Conventional: Integral gain of current loop HRV: Integral gain of current loop		○			C	135
6908	6948	3288	3508	3144	4144	Depends on the model	Conventional: Velocity at which current loop integral gain is zero HRV: Velocity at which current loop integral gain is zero		○			C	136
6909	6949	3289	3509	3145	4145	Depends on the model	Conventional: Velocity factor for proportional gain of current loop HRV: Filter time constant for processing saturation related to the voltage command		○			C	137

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6910	6950	3290	3510	3146	4146	Depends on the model	Conventional: Current conversion constant HRV: Current conversion constant		○			C	138
6911	6951	3291	3511	3147	4147	Depends on the model	Conventional: Secondary current factor for activating current HRV: Secondary current factor		○			C	139
6912	6952	3292	3512	3148	4148	Depends on the model	Conventional: Expected–current constant HRV: Criterion level for saturation related to the voltage command/PWM command clamp value		○			C	140
6913	6953	3293	3513	3149	4149	Depends on the model	Conventional: Slip constant HRV: Slip constant		○			C	141
6914	6954	3294	3514	3150	4150	Depends on the model	Conventional: Compensation constant for high–speed–rotation slip HRV: Slip compensation coefficient for a high–speed zone/slip compensation coefficient at deceleration		○			C	142
6915	6955	3295	3515	3151	4151	Depends on the model	Conventional: Compensation constant for voltage applied to motor in dead zone HRV: PWM command clamp value at deceleration		○			C	143
6916	6956	3296	3516	3152	4152	Depends on the model	Conventional: Compensation constant for electromotive force HRV: Motor leakage constant		○			C	144
6917	6957	3297	3517	3153	4153	Depends on the model	Conventional: Compensation constant for phase of electromotive force HRV: Regular–time voltage compensation coefficient for high–speed zone/regular–time motor voltage coefficient		○			C	145
6918	6958	3298	3518	3154	4154	Depends on the model	Conventional: Electromotive force compensation speed factor HRV: Acceleration–time voltage compensation coefficient for high–speed zone/acceleration–time motor voltage coefficient		○			C	146
6919	6959	3299	3519	3155	4155	0	Conventional: Voltage compensation factor during deceleration HRV:		○			C	147
6920	6960	3300	3520	3156	4156	0	Temperature factor gain		○			C	148

FS0		FS15		FS15*i*	FS16*i*/16	Standard initial setting data	Contents	Application				Classi-fication	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6921	6961	3301	3521	3157	4157	5	Time constant for changing the torque		○			B	149
6922	6962	3302	3522	3158	4158	Depends on the model	Conventional: Velocity at which maximum output limit is zero HRV: Maximum torque curve compensation coefficient		○			C	150
6923	6963	3303	3523	3159	4159	Depends on the model	Conventional: Secondary current factor for rigid tapping HRV: Secondary current factor for rigid tapping		○			C	151
6924	6964	3304	3524	3160	4160	0	Hysteresis of speed detection level	○	○	○	○	D	152
6925	6965	3305	3525	3161	4161	Depends on the model	Conventional: Compensation factor for phase of electromotive force during deceleration HRV: Current loop proportional gain speed coefficient/current phase delay compensation coefficient		○			C	153
6926	6966	3306	3526	3162	4162	0	Integral gain of velocity loop during cutting feed in Cs contour control mode (HIGH)	○	○			B	154
6927	6967	3307	3527	3163	4163	0	Integral gain of velocity loop during cutting feed in Cs contour control mode (LOW)	○	○			B	155
6928	6968	3308	3528	3164	4164	0	Current conversion constant for V phase		○			B	156
6929	6969	3309	3529	3165	4165	0	Conventional: Time constant for voltage filter for electromotive force compensation HRV: Deceleration–time activating current change time constant/activating current change time constant		○			B	157
6930	6970	3310	3530	3166	4166	Depends on the model	Conventional: Regenerative power limit HRV: Regenerative power limit for high–speed zone/regenerative power limit		○			C	158
6931	6971	3311	3531	3167	4167	0							159
6932	6972	3312	3532	3168	4168	Depends on the model	Current overload alarm detection level (for low–speed characteristics)		○			C	160
6933	6973	3313	3533	3169	4169	Depends on the model	Current overload alarm detection time constant	○	○			C	161
6934	6974	3314	3534	3170	4170	Depends on the model	Current overload alarm detection level (for high–speed characteristics)	○				C	162
6935	6975	3315	3535	3171	4171	0	Number of spindle gear teeth (HIGH)	○	○			B	163

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6936	6976	3316	3536	3172	4172	0	Number of position detector gear teeth (HIGH)	○	○			B	164
6937	6977	3317	3537	3173	4173	0	Number of spindle gear teeth (LOW)	○	○			B	165
6938	6978	3318	3538	3174	4174	0	Number of position detector gear teeth (LOW)	○	○			B	166
6939	6979	3319	3539	3175	4175	0	Analog override zero level	○	○	○	○	B	167

A.3 PARAMETERS FOR HIGH–SPEED CHARACTERISTICS, SPINDLE SWITCHING SUB SIDE

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fication	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6140#0	6320#0	3320#0	3540#0	3176#0	4176#0	0	Spindle and motor rotation direction			○	○	A	168#8
6140#1	6320#1	3320#1	3540#1	3176#1	4176#1	0							168#9
6140#2	6320#2	3320#2	3540#2	3176#2	4176#2	0	Mounting direction of the position coder			○	○	A	168#10
6140#3	6320#3	3320#3	3540#3	3176#3	4176#3	0							168#11
6140#4	6320#4	3320#4	3540#4	3176#4	4176#4	0	Return direction for the reference position in servo mode			○	○	B	168#12
6140#5	6320#5	3320#5	3540#5	3176#5	4176#5	0							168#13
6140#6	6320#6	3320#6	3540#6	3176#6	4176#6	0							168#14
6140#7	6320#7	3320#7	3540#7	3176#7	4176#7	0							168#15
6141#0	6321#0	3321#0	3541#0	3177#0	4177#0	1	Whether to use MRDY (machine ready) signal			○	○	B	168#0
6141#1	6321#1	3321#1	3541#1	3177#1	4177#1	0							168#1
6141#2	6321#2	3321#2	3541#2	3177#2	4177#2	0	Whether to use the position coder signal			○	○	A	168#2
6141#3	6321#3	3321#3	3541#3	3177#3	4177#3	0	Mounting direction of the magnetic sensor			○	○	A	168#3
6141#4	6321#4	3321#4	3541#4	3177#4	4177#4	0							168#4
6141#5	6321#5	3321#5	3541#5	3177#5	4177#5	0							168#5
6141#6	6321#6	3321#6	3541#6	3177#6	4177#6	0							168#6
6141#7	6321#7	3321#7	3541#7	3177#7	4177#7	0							168#7
6142#0	6322#0	3322#0	3542#0	3178#0	4178#0	0							169#8
6142#1	6322#1	3322#1	3542#1	3178#1	4178#1	0							169#9
6142#2	6322#2	3322#2	3542#2	3178#2	4178#2	0							169#10
6142#3	6322#3	3322#3	3542#3	3178#3	4178#3	0							169#11
6142#4	6322#4	3322#4	3542#4	3178#4	4178#4	0							169#12
6142#5	6322#5	3322#5	3542#5	3178#5	4178#5	0	Rotation direction signal function in servo mode			○	○	B	169#13
6142#6	6322#6	3322#6	3542#6	3178#6	4178#6	0							169#14
6142#7	6322#7	3322#7	3542#7	3178#7	4178#7	0							169#15
6143#0	6323#0	3323#0	3543#0	3179#0	4179#0	0	Selection between orientation by position coder and that by magnetic sensor			○	○	B	169#0
6143#1	6323#1	3323#1	3543#1	3179#1	4179#1	0	Whether to use MZ sensor (built–in sensor with built–in motor)			○	○	A	169#1
#3,2	#3,2	#3,2	#3,2	#3,2	#3,2	0,0	Rotation direction during spindle orientation			○	○	A	#3,2
#7,6,4	#7,6,4	#7,6,4	#7,6,4	#7,6,4	#7,6,4	0,0,0	Setting of the position coder signal			○	○	A	#7,6,4
6143#5	6323#5	3323#5	3543#5	3179#5	4179#5	0							169#5
6144#0	6324#0	3324#0	3544#0	3180#0	4180#0	0							170#8

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6144#1	6324#1	3324#1	3544#1	3180#1	4180#1	0							170#9
6144#2	6324#2	3324#2	3544#2	3180#2	4180#2	0	Whether to use external one–rotation signal			○	○	A	170#10
6144#3	6324#3	3324#3	3544#3	3180#3	4180#3	0	Setting of external one–rotation signal detection edge			○	○	A	170#11
6144#4	6324#4	3324#4	3544#4	3180#4	4180#4	0	Setup of MZ sensor (built–in sensor with built–in motor)			○	○	A	170#12
6144#5	6324#5	3324#5	3544#5	3180#5	4180#5	0							170#13
6144#6	6324#6	3324#6	3544#6	3180#6	4180#6	0							170#14
6144#7	6324#7	3324#7	3544#7	3180#7	4180#7	0							170#15
6145#0	6325#0	3325#0	3545#0	3181#0	4181#0	0							170#0
6145#1	6325#1	3325#1	3545#1	3181#1	4181#1	0							170#1
6145#2	6325#2	3325#2	3545#2	3181#2	4181#2	0							170#2
6145#3	6325#3	3325#3	3545#3	3181#3	4181#3	0							170#3
6145#4	6325#4	3325#4	3545#4	3181#4	4181#4	0							170#4
6145#5	6325#5	3325#5	3545#5	3181#5	4181#5	0							170#5
6145#6	6325#6	3325#6	3545#6	3181#6	4181#6	0							170#6
6145#7	6325#7	3325#7	3545#7	3181#7	4181#7	0							170#7
6146#0	6326#0	3326#0	3546#0	3182#0	4182#0	0							171#8
6146#1	6326#1	3326#1	3546#1	3182#1	4182#1	0	Setting of gear ratio resolution			○	○	B	171#9
6146#2	6326#2	3326#2	3546#2	3182#2	4182#2	0	Setting in $10min^{-1}$ units			○	○	C	171#10
6146#3	6326#3	3326#3	3546#3	3182#3	4182#3	0							171#11
6146#4	6326#4	3326#4	3546#4	3182#4	4182#4	0							171#12
6146#5	6326#5	3326#5	3546#5	3182#5	4182#5	0	Setting of analog over-ride range			○	○	B	171#13
6146#6	6326#6	3326#6	3546#6	3182#6	4182#6	0							171#14
6146#7	6326#7	3326#7	3546#7	3182#7	4182#7	0	Setup of rigid tapping with MZ sensor (built–in sensor with built–in mo-tor)			○	○	B	171#15
6147#0	6327#0	3327#0	3547#0	3183#0	4183#0	0							171#0
6147#1	6327#1	3327#1	3547#1	3183#1	4183#1	0							171#1
6147#2	6327#2	3327#2	3547#2	3183#2	4183#2	0							171#2
6147#3	6327#3	3327#3	3547#3	3183#3	4183#3	0							171#3
6147#4	6327#4	3327#4	3547#4	3183#4	4183#4	0							171#4
6147#5	6327#5	3327#5	3547#5	3183#5	4183#5	0	Whether to detect dis-connection of position coder signal			○	○	D	171#5
6147#6	6327#6	3327#6	3547#6	3183#6	4183#6	0	Whether to detect alarms (AL–41, 42, and 47) related to position coder signal			○	○	D	171#6
6147#7	6327#7	3327#7	3547#7	3183#7	4183#7	0	Setting of motor voltage pattern at no load			○	○	C	171#7
6148#0	6328#0	3328#0	3548#0	3184#0	4184#0	Depends on the model	Setup of electromotive force compensation (high–speed winding)			○		C	172#8
6148#1	6328#1	3328#1	3548#1	3184#1	4184#1	Depends on the model	Setup of electromotive force compensation (low–speed winding)				○	C	172#9
6148#2	6328#2	3328#2	3548#2	3184#2	4184#2	0							172#10
6148#3	6328#3	3328#3	3548#3	3184#3	4184#3	0							172#11

FS0		FS15		FS15i	FS16i /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6148#4	6328#4	3328#4	3548#4	3184#4	4184#4	0							172#12
6148#5	6328#5	3328#5	3548#5	3184#5	4184#5	0							172#13
6148#6	6328#6	3328#6	3548#6	3184#6	4184#6	0							172#14
6148#7	6328#7	3328#7	3548#7	3184#7	4184#7	0							172#15
6149#0	6329#0	3329#0	3549#0	3185#0	4185#0	0	Setting of units of velocity loop gain			○	○	B	172#0
6149#1	6329#1	3329#1	3549#1	3185#1	4185#1	0							172#1
6149#2	6329#2	3329#2	3549#2	3185#2	4185#2	0	Method of cutting off motor power when AL–24 occurs			○	○	D	172#2
6149#3	6329#3	3329#3	3549#3	3185#3	4185#3	0	Arbitrary gear ratio between spindle and position coder			○	○	B	172#3
6149#4	6329#4	3329#4	3549#4	3185#4	4185#4	0	Setting of load detection signal output condition			○	○	B	172#4
6149#5	6329#5	3329#5	3549#5	3185#5	4185#5	Depends on the model	Setting of output compensation method			○	○	C	172#5
6149#6	6329#6	3329#6	3549#6	3185#6	4185#6	0	Analog override type			○	○	B	172#6
6149#7	6329#7	3329#7	3549#7	3185#7	4185#7	0							172#7
6150#0	6330#0	3330#0	3550#0	3186#0	4186#0	0							173#8
6150#1	6330#1	3330#1	3550#1	3186#1	4186#1	0							173#9
6150#2	6330#2	3330#2	3550#2	3186#2	4186#2	0							173#10
6150#3	6330#3	3330#3	3550#3	3186#3	4186#3	0							173#11
6150#4	6330#4	3330#4	3550#4	3186#4	4186#4	0							173#12
6150#5	6330#5	3330#5	3550#5	3186#5	4186#5	0							173#13
6150#6	6330#6	3330#6	3550#6	3186#6	4186#6	0							173#14
6150#7	6330#7	3330#7	3550#7	3186#7	4186#7	0							173#15
6151#2, 1,0	6331#2, 1,0	3331#2, 1,0	3551#2, 1,0	3187#2, 1,0	4187#2, 1,0	Depends on the model	Setup of velocity detector			○	○	A	173#2,1, 0
6151#7, 3	6331#7, 3	3331#7, 3	3551#7, 3	3187#7, 3	4187#7, 3	Depends on the model	Number of motor poles			○	○	C	173#7,3
6151#4	6331#4	3331#4	3551#4	3187#4	4187#4	Depends on the model	Setting of maximum output during acceleration/deceleration			○	○	C	173#4
6151#5	6331#5	3331#5	3551#5	3187#5	4187#5	Depends on the model	Condition for deciding acceleration/deceleration during maximum output acceleration/deceleration			○	○	C	173#5
6151#6	6331#6	3331#6	3551#6	3187#6	4187#6	0							173#6
6152#1, 0	6332#1, 0	3332#1, 0	3552#1, 0	3188#1, 0	4188#1, 0	Depends on the model	Setting of PWM carrier frequency			○	○		174#9,8
6152#2	6332#2	3332#2	3552#2	3188#2	4188#2	0							174#10
6152#3	6332#3	3332#3	3552#3	3188#3	4188#3	0							174#11
6152#4	6332#4	3332#4	3552#4	3188#4	4188#4	0							174#12
6152#5	6332#5	3332#5	3552#5	3188#5	4188#5	0							174#13
6152#6	6332#6	3332#6	3552#6	3188#6	4188#6	0							174#14
6152#7	6332#7	3332#7	3552#7	3188#7	4188#7	0							174#15
6153#0	6333#0	3333#0	3553#0	3189#0	4189#0	0	Setting of position coder one–rotation signal detection edge			○	○	A	174#0
6153#1	6333#1	3333#1	3553#1	3189#1	4189#1	1							174#1

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6153#6, 5,4,3,2	6333#6, 5,4,3,2	3333#6, 5,4,3,2	3553#6, 5,4,3,2	3189#6, 5,4,3,2	4189#6, 5,4,3,2	Depends on the model	Current dead zone data			○	○	C	174#6,5, 4,3,2
6153#7	6333#7	3333#7	3553#7	3189#7	4189#7	0	PWM frequency of output switching low–speed winding			○	○	B	174#7
6154#0	6334#0	3334#0	3554#0	3190#0	4190#0	0							175#8
6154#1	6334#1	3334#1	3554#1	3190#1	4190#1	0							175#9
6154#2	6334#2	3334#2	3554#2	3190#2	4190#2	0							175#10
6154#3	6334#3	3334#3	3554#3	3190#3	4190#3	0							175#11
6154#4	6334#4	3334#4	3554#4	3190#4	4190#4	0							175#12
6154#5	6334#5	3334#5	3554#5	3190#5	4190#5	0							175#13
6154#6	6334#6	3334#6	3554#6	3190#6	4190#6	0							175#14
6154#7	6334#7	3334#7	3554#7	3190#7	4190#7	0							175#15
6155#0	6335#0	3335#0	3555#0	3191#0	4191#0	0							175#0
6155#1	6335#1	3335#1	3555#1	3191#1	4191#1	0							175#1
6155#2	6335#2	3335#2	3555#2	3191#2	4191#2	0							175#2
6155#3	6335#3	3335#3	3555#3	3191#3	4191#3	0							175#3
6155#4	6335#4	3335#4	3555#4	3191#4	4191#4	0							175#4
6155#5	6335#5	3335#5	3555#5	3191#5	4191#5	0							175#5
6155#6	6335#6	3335#6	3555#6	3191#6	4191#6	0							175#6
6155#7	6335#7	3335#7	3555#7	3191#7	4191#7	0							175#7
6156#0	6336#0	3336#0	3556#0	3192#0	4192#0	0							176#8
6156#1	6336#1	3336#1	3556#1	3192#1	4192#1	0							176#9
6156#2	6336#2	3336#2	3556#2	3192#2	4192#2	0							176#10
6156#3	6336#3	3336#3	3556#3	3192#3	4192#3	0	Whether to use smoothing function during feed–forward control			○	○	B	176#11
6156#4	6336#4	3336#4	3556#4	3192#4	4192#4	0							176#12
6156#5	6336#5	3336#5	3556#5	3192#5	4192#5	0							176#13
6156#6	6336#6	3336#6	3556#6	3192#6	4192#6	0	Whether to use one–rotation signal misdetection (AL–46) function of position coder signal			○	○	B	176#14
6156#7	6336#7	3336#7	3556#7	3192#7	4192#7	0	Setting of one–rotation signal detection condition			○	○	B	176#15
6157#0	6337#0	3337#0	3557#0	3193#0	4193#0	0							176#0
6157#1	6337#1	3337#1	3557#1	3193#1	4193#1	0							176#1
6157#2	6337#2	3337#2	3557#2	3193#2	4193#2	0	Whether to use the position coder one–rotation signal detection function during normal rotation			○	○	B	176#2
6157#3	6337#3	3337#3	3557#3	3193#3	4193#3	0	Whether to use the position coder one–rotation signal detection function during orientation by magnetic sensor			○	○	B	176#3
6157#4	6337#4	3337#4	3557#4	3193#4	4193#4	0							176#4
6157#5	6337#5	3337#5	3557#5	3193#5	4193#5	0							176#5
6157#6	6337#6	3337#6	3557#6	3193#6	4193#6	0							176#6

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6157#7	6337#7	3337#7	3557#7	3193#7	4193#7	0	Whether to use short–cut function during orientation from stopped state			○	○	B	176#7
6158#0	6338#0	3338#0	3558#0	3194#0	4194#0	0				○	○	B	177#8
6158#1	6338#1	3338#1	3558#1	3194#1	4194#1	0				○	○	B	177#9
6158#2	6338#2	3338#2	3558#2	3194#2	4194#2	0							177#10
6158#3	6338#3	3338#3	3558#3	3194#3	4194#3	0							177#11
6158#4	6338#4	3338#4	3558#4	3194#4	4194#4	0							177#12
6158#5	6338#5	3338#5	3558#5	3194#5	4194#5	0	Whether to use velocity command compensation function during high–speed orientation			○	○	B	177#13
6158#6	6338#6	3338#6	3558#6	3194#6	4194#6	0	Whether to use the high–speed orientation function			○	○	B	177#14
6158#7	6338#7	3338#7	3558#7	3194#7	4194#7	0							177#15
6159#0	6339#0	3339#0	3559#0	3195#0	4195#0	0	Whether to compensate dead zone during orientation			○	○	B	177#0
6159#1	6339#1	3339#1	3559#1	3195#1	4195#1	0				○	○	B	177#1
6159#2	6339#2	3339#2	3559#2	3195#2	4195#2	1	Whether to use torque clamp at zero speed			○	○	C	177#2
6159#3	6339#3	3339#3	3559#3	3195#3	4195#3	0				○	○	C	177#3
6159#4	6339#4	3339#4	3559#4	3195#4	4195#4	0	Setting of winding switching condition during output switching			○	○	B	177#4
6159#5	6339#5	3339#5	3559#5	3195#5	4195#5	0	Setup of DC link voltage detection filter			○	○	B	177#5
6159#6	6339#6	3339#6	3559#6	3195#6	4195#6	0				○	○	C	177#6
6159#7	6339#7	3339#7	3559#7	3195#7	4195#7	0	Automatic parameter setting function			○	○	B	177#7
6160	6340	3340	3560	3196	4196	Depends on the model	Maximum motor speed			○	○	C	178
6161	6341	3341	3561	3197	4197	150	Speed arrival detection level			○	○	B	179
6162	6342	3342	3562	3198	4198	30	Speed detection level			○	○	B	180
6163	6343	3343	3563	3199	4199	75	Zero speed detection level			○	○	B	181
6164	6344	3344	3564	3200	4200	50	Limited torque			○	○	B	182
6165	6345	3345	3565	3201	4201	83	Load detection level 1			○	○	B	183
6166	6346	3346	3566	3202	4202	0	Limited output pattern			○	○	B	184
6167	6347	3347	3567	3203	4203	100	Output limit			○	○	B	185
6168	6348	3348	3568	3204	4204	0	Stop position in orientation by position coder			○	○	B	186
6169	6349	3349	3569	3205	4205	0	Spindle orientation speed			○	○	B	187
6170	6350	3350	3570	3206	4206	10	Proportional gain of velocity loop during normal operation (HIGH)			○	○	B	188
6171	6351	3351	3571	3207	4207	10	Proportional gain of velocity loop during normal operation (LOW)			○	○	B	189
6172	6352	3352	3572	3208	4208	10	Proportional gain of velocity loop during orientation (HIGH)			○	○	B	190

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6173	6353	3353	3573	3209	4209	10	Proportional gain of velocity loop during orientation (LOW)			○	○	B	191
6174	6354	3354	3574	3210	4210	10	Proportional gain of velocity loop in servo mode (HIGH)			○	○	B	192
6175	6355	3355	3575	3211	4211	10	Proportional gain of velocity loop in servo mode (LOW)			○	○	B	193
6176	6356	3356	3576	3212	4212	10	Integral gain of velocity loop during normal operation			○	○	B	194
6177	6357	3357	3577	3213	4213	10	Integral gain of velocity loop during orientation			○	○	B	195
6178	6358	3358	3578	3214	4214	10	Integral gain of velocity loop in servo mode			○	○	B	196
6179	6359	3359	3579	3215	4215	0							197
6180	6360	3360	3580	3216	4216	100	Gear ratio (HIGH)			○	○	B	198
6181	6361	3361	3581	3217	4217	100	Gear ratio (LOW)			○	○	B	199
6182	6362	3362	3582	3218	4218	1000	Position gain during orientation (HIGH)			○	○	B	200
6183	6363	3363	3583	3219	4219	1000	Position gain during orientation (LOW)			○	○	B	201
6184	6364	3364	3584	3220	4220	100	Rate of change in position gain upon completion of orientation			○	○	B	202
6185	6365	3365	3585	3221	4221	1000	Position gain in servo mode/during synchronization control (HIGH)			○	○	B	203
6186	6366	3366	3586	3222	4222	1000	Position gain in servo mode/during synchronization control (LOW)			○	○	B	204
6187	6367	3367	3587	3223	4223	0	Grid shift in servo mode			○	○	B	205
6188	6368	3368	3588	3224	4224	0							206
6189	6369	3369	3589	3225	4225	0							207
6190	6370	3370	3590	3226	4226	10	Level for orientation completion signal			○	○	B	208
6191	6371	3371	3591	3227	4227	33	Motor speed limit during orientation			○	○	B	209
6192	6372	3372	3592	3228	4228	0	Orientation stop position shift			○	○	B	210
6193	6373	3373	3593	3229	4229	Depends on the sensor	MS signal constant			○	○	B	211
6194	6374	3374	3594	3230	4230	0	MS signal gain adjustment			○	○	B	212
6195	6375	3375	3595	3231	4231	Depends on the model	Regenerative power limit			○		C	213
6196	6376	3376	3596	3232	4232	20	Delay time until motor power is cut off			○	○	B	214
6197	6377	3377	3597	3233	4233	10	Setting of acceleration/deceleration time			○	○	B	215
6198	6378	3378	3598	3234	4234	0	Spindle load monitor observer gain 1 (SUB side)			○	○	B	216
6199	6379	3379	3599	3235	4235	0	Spindle load monitor observer gain 2 (SUB side)			○	○	B	217

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6200	6380	3380	3600	3236	4236	Depends on the model	Motor voltage during normal rotation			○		B	218
6201	6381	3381	3601	3237	4237	Depends on the model	Motor voltage during orientation			○	○	B	219
6202	6382	3382	3602	3238	4238	Depends on the model	Motor voltage in servo mode			○		B	220
6203	6383	3383	3603	3239	4239	100	Rate of change in position gain during reference position return in servo mode			○	○	B	221
6204	6384	3384	3604	3240	4240	0	Feed–forward factor			○	○	B	222
6205	6385	3385	3605	3241	4241	0	Feed–forward factor of velocity loop			○	○	B	223
6206	6386	3386	3606	3242	4242	0							224
6207	6387	3387	3607	3243	4243	0	Number of spindle gear teeth (HIGH)			○	○	B	225
6208	6388	3388	3608	3244	4244	0	Number of position detector gear teeth (HIGH)			○	○	B	226
6209	6389	3389	3609	3245	4245	0	Number of spindle gear teeth (LOW)			○	○	B	227
6210	6390	3390	3610	3246	4246	0	Number of position detector gear teeth (LOW)			○	○	B	228
6211	6391	3391	3611	3247	4247	0	Time constant for spindle load monitor magnetic flux compensation (MAIN side for low–speed characteristics)	○				B	229
6212	6392	3392	3612	3248	4248	0	Spindle load monitor torque constant (MAIN side for high–speed characteristics)	○				B	230
6213	6393	3393	3613	3249	4249	0	Spindle load monitor observer gain 1 (MAIN side)	○	○			B	231
6214	6394	3394	3614	3250	4250	0	Spindle load monitor observer gain 2 (MAIN side)	○	○			B	232
6215	6395	3395	3615	3251	4251	0	Time constant for spindle load monitor magnetic flux compensation (MAIN side for low–speed characteristics)		○			B	233
6216	6396	3396	3616	3252	4252	0	Time constant for spindle load monitor magnetic flux compensation (SUB side for high–speed characteristics)			○		B	234
6217	6397	3397	3617	3253	4253	0	Time constant for spindle load monitor magnetic flux compensation (SUB side for low–speed characteristics)				○	B	235
6218	6398	3398	3618	3254	4254	0	Temperature compensation gain (SUB side for high–speed characteristics)			○		C	236

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6219	6399	3399	3619	3255	4255	0	Temperature compensation gain (SUB side for low–speed characteristics)				○	C	237
6220	6400	3400	3620	3256	4256	Depends on the model	Base speed of motor output specifications			○		C	238
6221	6401	3401	3621	3257	4257	Depends on the model	Output limit for motor output specifications			○		C	239
6222	6402	3402	3622	3258	4258	Depends on the model	Base speed			○		C	240
6223	6403	3403	3623	3259	4259	Depends on the model	Speed at which decrease in magnetic flux begins			○		C	241
6224	6404	3404	3624	3260	4260	Depends on the model	Proportional gain of current loop			○		C	242
6225	6405	3405	3625	3261	4261	Depends on the model	Integral gain of current loop			○		C	243
6226	6406	3406	3626	3262	4262	Depends on the model	Velocity at which current loop integral gain is zero			○		C	244
6227	6407	3407	3627	3263	4263	Depends on the model	Velocity factor for proportional gain of current loop			○		C	245
6228	6408	3408	3628	3264	4264	Depends on the model	Current conversion constant			○		C	246
6229	6409	3409	3629	3265	4265	Depends on the model	Secondary current factor for activating current			○		C	247
6230	6410	3410	3630	3266	4266	Depends on the model	Expected–current constant			○		C	248
6231	6411	3411	3631	3267	4267	Depends on the model	Slip constant			○		C	249
6232	6412	3412	3632	3268	4268	Depends on the model	Compensation constant for high–speed–rotation slip			○		C	250
6233	6413	3413	3633	3269	4269	Depends on the model	Compensation constant for voltage applied to motor in dead zone			○		C	251
6234	6414	3414	3634	3270	4270	Depends on the model	Compensation constant for electromotive force			○		C	252
6235	6415	3415	3635	3271	4271	Depends on the model	Compensation constant for phase of electromotive force			○		C	253
6236	6416	3416	3636	3272	4272	Depends on the model	Electromotive force compensation speed factor			○		C	254
6237	6417	3417	3637	3273	4273	5	Time constant for changing the torque			○		B	255
6238	6418	3418	3638	3274	4274	Depends on the model	Value displayed on load meter at maximum output			○	○	C	256
6239	6419	3419	3639	3275	4275	Depends on the model	Velocity at which maximum output limit is zero			○		C	257

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6240	6420	3420	3640	3276	4276	Depends on the model	Secondary current factor for rigid tapping			○		C	258
6241	6421	3421	3641	3277	4277	Depends on the model	Compensation factor for phase of electromotive force during deceleration			○		C	259
6242	6422	3422	3642	3278	4278	0	Time constant for velocity detecting filter			○	○	C	260
6243	6423	3423	3643	3279	4279	0							261
6244	6424	3424	3644	3280	4280	0	Time constant for voltage filter for electromotive force compensation			○		C	262
6245	6425	3425	3645	3281	4281	0	Spindle load monitor torque constant (MAIN side for low–speed characteristics)		○			B	263
6246	6426	3426	3646	3282	4282	0	Spindle load monitor torque constant (SUB side for high–speed characteristics)			○		B	264
6247	6427	3427	3647	3283	4283	0	Spindle load monitor torque constant (SUB side for low–speed characteristics)				○	B	265

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
–	–	3737#0	3779#0	3373#0	4373#0	0							356#8
–	–	3737#1	3779#1	3373#1	4373#1	0							356#9
–	–	3737#2	3779#2	3373#2	4373#2	0							356#10
–	–	3737#3	3779#3	3373#3	4373#3	0							356#11
–	–	3737#4	3779#4	3373#4	4373#4	0							356#12
–	–	3737#5	3779#5	3373#5	4373#5	0							356#13
–	–	3737#6	3779#6	3373#6	4373#6	0							356#14
–	–	3737#7	3779#7	3373#7	4373#7	0							356#15
–	–	3738#0	3780#0	3374#0	4374#0	0							356#0
–	–	3738#1	3780#1	3374#1	4374#1	0							356#1
–	–	3738#2	3780#2	3374#2	4374#2	0							356#2
–	–	3738#3	3780#3	3374#3	4374#3	0							356#3
–	–	3738#4	3780#4	3374#4	4374#4	0							356#4
–	–	3738#5	3780#5	3374#5	4374#5	0							356#5
–	–	3738#6	3780#6	3374#6	4374#6	0							356#6
–	–	3738#7	3780#7	3374#7	4374#7	0							356#7
–	–	3739	3781	3375	4375	0							357
–	–	3740	3782	3376	4376	0							358
–	–	3741	3783	3377	4377	0							359
–	–	3742	3784	3378	4378	0							360
–	–	3743	3785	3379	4379	0							361
–	–	3744	3786	3380	4380	0							362
–	–	3745	3787	3381	4381	0							363
–	–	3746	3788	3382	4382	0							364
–	–	3747	3789	3383	4383	0							365
–	–	3748	3790	3384	4384	0							366
–	–	3749	3791	3385	4385	0							367
–	–	3750	3792	3386	4386	0							368
–	–	3751	3793	3387	4387	0							369
–	–	3752	3794	3388	4388	0							370
–	–	3753	3795	3389	4389	0							371
–	–	3754	3796	3390	4390	0							372
–	–	3755	3797	3391	4391	0							373
–	–	3756	3798	3392	4392	0							374
–	–	3757	3799	3393	4393	0							375

A.4 PARAMETERS FOR LOW–SPEED CHARACTERISTICS, SPINDLE SWITCHING SUB SIDE

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application MAIN high speed	Application MAIN low speed	Application SUB high speed	Application SUB low speed	Classi-fica-tion	Internal data number F–xxx
6248	6428	3428	3648	3284	4284	Depends on the model	Motor voltage during normal rotation				○	B	266
6249	6429	3429	3649	3285	4285	Depends on the model	Motor voltage in servo mode				○	B	267
6250	6430	3430	3650	3286	4286	Depends on the model	Base speed of motor output specifications				○	C	268
6251	6431	3431	3651	3287	4287	Depends on the model	Output limit for motor output specifications				○	C	269
6252	6432	3432	3652	3288	4288	Depends on the model	Base speed				○	C	270
6253	6433	3433	3653	3289	4289	Depends on the model	Speed at which decrease in magnetic flux begins				○	C	271
6254	6434	3434	3654	3290	4290	Depends on the model	Proportional gain of current loop				○	C	272
6255	6435	3435	3655	3291	4291	Depends on the model	Integral gain of current loop				○	C	273
6256	6436	3436	3656	3292	4292	Depends on the model	Velocity at which current loop integral gain is zero				○	C	274
6257	6437	3437	3657	3293	4293	Depends on the model	Velocity factor for proportional gain of current loop				○	C	275
6258	6438	3438	3658	3294	4294	Depends on the model	Current conversion constant				○	C	276
6259	6439	3439	3659	3295	4295	Depends on the model	Secondary current factor for activating current				○	C	277
6260	6440	3440	3660	3296	4296	Depends on the model	Expected–current constant				○	C	278
6261	6441	3441	3661	3297	4297	Depends on the model	Slip constant				○	C	279
6262	6442	3442	3662	3298	4298	Depends on the model	Compensation constant for high–speed–rotation slip				○	C	280
6263	6443	3443	3663	3299	4299	Depends on the model	Compensation constant for voltage applied to motor in dead zone				○	C	281
6264	6444	3444	3664	3300	4300	Depends on the model	Compensation constant for electromotive force				○	C	282
6265	6445	3445	3665	3301	4301	Depends on the model	Compensation constant for phase of electromotive force				○	C	283

FS0 1st Spindle	FS0 2nd Spindle	FS15 1st Spindle	FS15 2nd Spindle	FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application: MAIN high speed	Application: MAIN low speed	Application: SUB high speed	Application: SUB low speed	Classi-fica-tion	Internal data number F–xxx
6266	6446	3446	3666	3302	4302	Depends on the model	Electromotive force compensation speed factor				○	C	284
6267	6447	3447	3667	3303	4303	5	Time constant for changing the torque				○	B	285
6268	6448	3448	3668	3304	4304	Depends on the model	Velocity at which maximum output limit is zero				○	C	286
6269	6449	3449	3669	3305	4305	Depends on the model	Secondary current factor for rigid tapping				○	C	287
6270	6450	3450	3670	3306	4306	Depends on the model	Compensation factor for phase of electromotive force during deceleration				○	C	288
6271	6451	3451	3671	3307	4307	Depends on the model	Regenerative power limit				○	C	289
6272	6452	3452	3672	3308	4308	0	Time constant for voltage filter for electromotive force compensation				○	C	290
6273	6453	3453	3673	3309	4309	Depends on the model	Motor model code			○	○	C	291
6274	6454	3454	3674	3310	4310	0							292 293
6275	6455	3455	3675	3311	4311	0							294 295
6276	6456	3456	3676	3312	4312	0	Detection level 2 for completion signal for orientation by position coder (MAIN side)	○	○			B	296
6277	6457	3457	3677	3313	4313	0	Detection level 1 for completion signal for orientation by magnetic sensor (MAIN side)	○	○			B	297
6278	6458	3458	3678	3314	4314	0	Detection level 2 for completion signal for orientation by magnetic sensor (MAIN side)	○	○			B	298
6279	6459	3459	3679	3315	4315	0	Stop position shift in orientation by magnetic sensor (MAIN side)	○	○			B	299
6280	6460	3460	3680	3316	4316	0	Detection level 2 for completion signal for orientation by position coder (SUB side)			○	○	B	300
6281	6461	3461	3681	3317	4317	0	Detection level 1 for completion signal for orientation by magnetic sensor (SUB side)			○	○	B	301
6282	6462	3462	3682	3318	4318	0	Detection level 2 for completion signal for orientation by magnetic sensor (SUB side)			○	○	B	302
6283	6463	3463	3683	3319	4319	0	Stop position shift in orientation by magnetic sensor (SUB side)			○	○	B	303
6284	6464	3464	3684	3320	4320	0	Motor deceleration time constant (MAIN side, HIGH)	○	○			B	304
6285	6465	3465	3685	3321	4321	0	Motor deceleration time constant (MAIN side, MEDIUM HIGH)	○	○			B	305

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6286	6466	3466	3686	3322	4322	0	Motor deceleration time constant (MAIN side, MEDIUM LOW)	○	○			B	306
6287	6467	3467	3687	3323	4323	0	Motor deceleration time constant (MAIN side, LOW)	○	○			B	307
6288	6468	3468	3688	3324	4324	0	Motor deceleration time constant (SUB side, HIGH)			○	○	B	308
6289	6469	3469	3689	3325	4325	0	Motor deceleration time constant (SUB side, LOW)			○	○	B	309
6290	6470	3470	3690	3326	4326	0	Speed at which deceleration time constant limit starts (MAIN side, HIGH)	○	○			B	310
6291	6471	3471	3691	3327	4327	0	Speed at which deceleration time constant limit starts (SUB side, HIGH)			○	○	B	311
6292	6472	3472	3692	3328	4328	0	Command multiplication for spindle orientation by position coder (MAIN side)	○	○			B	312
6293	6473	3473	3693	3329	4329	0	Command multiplication for spindle orientation by position coder (SUB side)			○	○	B	313
6294	6474	3474	3694	3330	4330	0	Speed at which deceleration time constant limit starts (MAIN side, LOW)	○	○			B	314
6295	6475	3475	3695	3331	4331	0	Speed at which deceleration time constant limit starts (SUB side, LOW)			○	○	B	315
6296	6476	3476	3696	3332	4332	0							316
6297	6477	3477	3697	3333	4333	0							317
6298	6478	3478	3698	3334	4334	0	Arbitrary number of velocity detector pulses (MAIN side)	○	○			A	318
6299	6479	3479	3699	3335	4335	0	Arbitrary number of velocity detector pulses (SUB side)			○	○	A	319
6300	6480	3480	3700	3336	4336	0	Magnetic flux switching point for calculating acceleration/deceleration time constant during spindle synchronization	○	○			B	320
6301	6481	3481	3701	3337	4337	0	Velocity loop gain speed compensation factor (MAIN side)	○	○			B	321
6302	6482	3482	3702	3338	4338	0	Velocity loop gain speed compensation factor (SUB side)			○	○	B	322
6303	6483	3483	3703	3339	4339	0	Torque clamp level	○	○	○	○	C	323
6304	6484	3484	3704	3340	4340	0	Bell–shaped acceleration/deceleration time constant during spindle synchronization	○	○			B	324
6305	6485	3485	3705	3341	4341	0	Abnormal torque detection level	○	○	○	○	B	325
6306	6486	3486	3706	3342	4342	0							326
6307	6487	3487	3707	3343	4343	0							327

FS0		FS15		FS15*i*	FS16*i* /16	Standard initial setting data	Contents	Application				Classi-fica-tion	Internal data number F–xxx
1st Spindle	2nd Spindle	1st Spindle	2nd Spindle					MAIN high speed	MAIN low speed	SUB high speed	SUB low speed		
6308	6488	3488	3708	3344	4344	0	Advanced feed–forward factor	○	○	○	○	B	328
6309	6489	3489	3709	3345	4345	0	Spindle motor velocity command detection level	○	○	○	○	B	329
6310	6490	3490	3710	3346	4346	0	Incomplete integration factor	○	○	○	○	B	330
6311	6491	3491	3711	3347	4347	0	Level for detecting speed difference between spindles 1 and 2 during slave operation	○	○			B	331
6312	6492	3492	3712	3348	4348	Depends on the model	Current overload alarm detection level (for low–speed characteristics)				○	C	332
6313	6493	3493	3713	3349	4349	Depends on the model	Current overload alarm detection time constant			○	○	C	333
6314	6494	3494	3714	3350	4350	Depends on the model	Current overload alarm detection level (for high–speed characteristics)			○		C	334
6315	6495	3495	3715	3351	4351	0	Current detection offset compensation	○	○	○	○	C	335

B LIST OF SPINDLE PARAMETER NUMBERS

B.1 FOR FANUC Series 0

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
6500	←	6140	←	6640	←	6320	←	Bit parameter
6501	←	6141	←	6641	←	6321	←	Bit parameter
6502	←	6142	←	6642	←	6322	←	Bit parameter
6503	←	6143	←	6643	←	6323	←	Bit parameter
6504	←	6144	←	6644	←	6324	←	Bit parameter
6505	←	6145	←	6645	←	6325	←	Bit parameter
6506	←	6146	←	6646	←	6326	←	Bit parameter
6507	←	6147	←	6647	←	6327	←	Bit parameter
6508	←	6148	←	6648	←	6328	←	Bit parameter
6509	←	6149	←	6649	←	6329	←	Bit parameter
6510	←	6150	←	6650	←	6330	←	Bit parameter
6511	←	6151	←	6651	←	6331	←	Bit parameter
6512	←	6152	←	6652	←	6332	←	Bit parameter
6513	←	6153	←	6653	←	6333	←	Bit parameter
6514	←	←	←	6654	←	←	←	Bit parameter
6515	←	←	←	6655	←	←	←	Bit parameter
6516	←	6156	←	6656	←	6336	←	Bit parameter
6517	←	6157	←	6657	←	6337	←	Bit parameter
6518	←	6158	←	6658	←	6338	←	Bit parameter
6519	←	6159	←	6659	←	6339	←	Bit parameter
6520	←	6160	←	6660	←	6340	←	Maximum motor speed
6521	←			6661	←			Maximum speed in Cs contour control mode
6522	←	6161	←	6662	←	6341	←	Speed arrival detection level
6523	←	6162	←	6663	←	6342	←	Speed detection level
6524	←	6163	←	6664	←	6343	←	Speed zero detection level
6525	←	6164	←	6665	←	6344	←	Limited torque
6526	←	6165	←	6666	←	6345	←	Load detection level 1
6527	←	←	←	6667	←	←	←	Load detection level 2
6528	←	6166	←	6668	←	6346	←	Limited output pattern
6529	←	6167	←	6669	←	6347	←	Output limit

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
6530	←	←	←	6670	←	←	←	Soft start/stop time
6531	←	6168	←	6671	←	6348	←	Stop position in orientation by position coder
6532	←	6169	←	6672	←	6349	←	Acceleration/deceleration time constant during spindle synchronization
6533	←			6673	←			Spindle speed to be detected in synchro- nization
6534	←			6674	←			Shift during synchronous control of spindle phase
6535	←			6675	←			Compensation data for spindle phase synchronization
6536	←	6204	←	6676	←	6384	←	Feed–forward factor
6537	←	6205	←	6677	←	6385	←	Feed–forward factor of velocity loop
6538	←	6169	←	6678	←	6349	←	Spindle orientation speed
6540	←	6170	←	6680	←	6350	←	Proportional gain of velocity loop during normal operation (HIGH)
6541	←	6171	←	6681	←	6351	←	Proportional gain of velocity loop during normal operation (LOW)
6542	←	6172	←	6682	←	6352	←	Proportional gain of velocity loop during orientation (HIGH)
6543	←	6173	←	6683	←	6353	←	Proportional gain of velocity loop during orientation (LOW)
6544	←	6174	←	6684	←	6354	←	Proportional gain of velocity loop in servo mode (HIGH)
6545	←	6175	←	6685	←	6355	←	Proportional gain of velocity loop in servo mode (LOW)
6546	←			6686	←			Proportional gain of velocity loop in Cs contour control mode (HIGH)
6547	←			6687	←			Proportional gain of velocity loop in Cs contour control mode (LOW)
6548	←	6176	←	6688	←	6356	←	Integral gain of velocity loop during normal operation (HIGH)
6549	←	↑	↑	6689	←	↑	↑	Integral gain of velocity loop during normal operation (LOW)
6550	←	6177	←	6690	←	6357	←	Integral gain of velocity loop during orientation (HIGH)
6551	←	↑	↑	6691	←	↑	↑	Integral gain of velocity loop during orientation (LOW)
6552	←	6178	←	6692	←	6358	←	Integral gain of velocity loop in servo mode (HIGH)
6553	←	↑	↑	6693	←	↑	↑	Integral gain of velocity loop in servo mode (LOW)
6554	←			6694	←			Integral gain of velocity loop in Cs contour control mode (HIGH)
6555	←			6695	←			Integral gain of velocity loop in Cs contour control mode (LOW)

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
6556	←	6180	←	6696	←	6360	←	Gear ratio (HIGH)
6557	←			6697	←			Gear ratio (MEDIUM HIGH)
6558	←			6698	←			Gear ratio (MEDIUM LOW)
6559	←	6181	←	6699	←	6361	←	Gear ratio (LOW)
6560	←	6182	←	6700	←	6362	←	Position gain during orientation (HIGH)
6561	←			6701	←			Position gain during orientation (MEDIUM HIGH)
6562	←			6702	←			Position gain during orientation (MEDIUM LOW)
6563	←	6183	←	6703	←	6363	←	Position gain during orientation (LOW)
6564	←	6184	←	6704	←	6364	←	Rate of change in position gain upon completion of orientation
6565	←	6185	←	6705	←	6365	←	Position gain in servo mode/during syn-chronization control (HIGH)
6566	←			6706	←			Position gain in servo mode/during syn-chronization control (MEDIUM HIGH)
6567	←			6707	←			Position gain in servo mode/during syn-chronization control (MEDIUM LOW)
6568	←	6186	←	6708	←	6366	←	Position gain in servo mode/during syn-chronization control (LOW)
6569	←			6709	←			Position gain in Cs contour control mode (HIGH)
6570	←			6710	←			Position gain in Cs contour control mode (MEDIUM HIGH)
6571	←			6711	←			Position gain in Cs contour control mode (MEDIUM LOW)
6572	←			6712	←			Position gain in Cs contour control mode (LOW)
6573	←	6187	←	6713	←	6367	←	Grid shift in servo mode
6574	←			6714	←			Reference position return speed in Cs contour control/servo mode
6575	←	6190	←	6715	←	6370	←	Detection level for orientation completion signal
6576	←	6191	←	6716	←	6371	←	Motor speed limit during orientation
6577	←	6192	←	6717	←	6372	←	Orientation stop position shift
6578	←	6193	←	6718	←	6373	←	MS signal constant
6579	←	6194	←	6719	←	6374	←	MS signal gain adjustment
6580	6930	6195	6271	6720	6970	6375	6451	Conventional : Regenerative power limit
								HRV : Regenerative power limit for high–speed zone/regenerative power limit
6581	←	6196	←	6721	←	6376	←	Delay time until motor power is cut off
6582	←	6197	←	6722	←	6377	←	Setting of acceleration/deceleration time
6583	6900	6200	6248	6723	6940	6380	6428	Motor voltage during normal rotation

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
6584	←	6201	←	6724	←	6381	←	Motor voltage during orientation
6585	6901	6202	6249	6725	6941	6382	6429	Motor voltage in servo mode/during syn- chronization control
6586	←			6726	←			Motor voltage in Cs contour control mode
6587	←	←	←	6727	←	←	←	Overspeed level
6588	←	←	←	6728	←	←	←	Level for detecting excess velocity devi- ation when motor is restrained
6589	←	←	←	6729	←	←	←	Level for detecting excess velocity devi- ation when motor rotates
6590	←	←	←	6730	←	←	←	Overload detection level
6591	←	6203	←	6731	←	6383	←	Rate of change in position gain during ref- erence position return in servo mode
6592	←	←	←	6732	←	←	←	Rate of change in position gain during ref- erence position return in Cs contour con- trol mode
6594	←			6734	←			Disturbance torque compensation constant
6595	←	←	←	6735	←	←	←	Adjusted output voltage of speedometer
6596	←	←	←	6736	←	←	←	Adjusted output voltage of load meter
6597	←			6737	←			Feedback gain of spindle speed
6598	←	←	←	6738	←	←	←	Maximum speed of position coder signal detection
6599	←	←	←	6739	←	←	←	Motor activation delay
6600	6902	6220	6250	6740	6942	6400	6430	Conventional : Base speed of motor out- put specifications
								HRV : Base speed of motor output specifi- cations
6601	6903	6221	6251	6741	6943	6401	6431	Conventional : Output limit for motor out- put specifications
								HRV : Torque–limit for motor output speci- fications
6602	6904	6222	6252	6742	6944	6402	6432	Conventional : Base speed
								HRV : Activating voltage saturation speed at no–load
6603	6905	6223	6253	6743	6945	6403	6433	Conventional : Speed at which decrease in magnetic flux begins
								HRV : Base speed limit ratio
6604	6906	6224	6254	6744	6946	6404	6434	Conventional : Proportional gain of current loop
								HRV : Proportional gain of current loop
6605	↑			6745	↑			Conventional : Proportional gain of current loop (in Cs contour control mode)
								HRV :

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
6606	6907	6225	6255	6746	6947	6405	6435	Conventional : Integral gain of current loop
								HRV : Integral gain of current loop
6607	↑			6747	↑			Conventional : Integral gain of current loop (in Cs contour control mode)
								HRV :
6608	6908	6226	6256	6748	6948	6406	6436	Conventional : Velocity at which the current loop integral gain is zero
								HRV : Velocity at which the current loop integral gain is zero
6609	6909	6227	6257	6749	6949	6407	6437	Conventional : Velocity factor for proportional gain of current loop
								HRV : Filter time constant for processing saturation related to the voltage command
6610	6910	6228	6258	6750	6950	6408	6438	Conventional : Current conversion constant
								HRV : Current conversion constant
6611	6911	6229	6259	6751	6951	6409	6439	Conventional : Secondary current factor for activating current
								HRV : Secondary current factor
6612	6912	6230	6260	6752	6952	6410	6440	Conventional : Expected–current constant
								HRV : Criterion level for saturation related to the voltage command/PWM command clamp value
6613	6913	6231	6261	6753	6953	6411	6441	Conventional : Slip constant
								HRV : Slip constant
6614	6914	6232	6262	6754	6954	6412	6442	Conventional : Compensation constant for high–speed–rotation slip
								HRV : Slip compensation coefficient for a high–speed zone/slip compensation coefficient at deceleration
6615	6915	6233	6263	6755	6955	6413	6443	Conventional : Compensation constant for voltage applied to motor in dead zone
								HRV : PWM command clamp value at deceleration
6616	6916	6234	6264	6756	6956	6414	6444	Conventional : Compensation constant for electromotive force
								HRV : Motor leakage constant
6617	6917	6235	6265	6757	6957	6415	6445	Conventional : Compensation constant for phase of electromotive force
								HRV : Regular–time voltage compensation coefficient for high–speed zone/regular–time motor voltage coefficient

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed characteristics	Low –speed characteristics	High –speed characteristics	Low –speed characteristics	High –speed characteristics	Low –speed characteristics	High –speed characteristics	Low –speed characteristics	
6618	6918	6236	6266	6758	6958	6416	6446	Conventional : Electromotive force compensation speed factor
								HRV : Acceleration–time voltage compensation coefficient for high–speed zone/ acceleration–time motor voltage coefficient
6619	6929	6244	6272	6759	6969	6424	6452	Conventional : Time constant for voltage filter for electromotive force compensation
								HRV : Deceleration–time activating current change time constant/activating current change time constant
6620	←	←	←	6760	←	←	←	Conventional : Dead band compensation data
								HRV : Rectangular–wave component zero voltage/dead–zone compensation data
6621	6921	6237	6267	6761	6961	6417	6447	Time constant for changing the torque
6622	←	6242	←	6762	←	6422	←	Time constant for velocity detecting filter
6623	←	←	←	6763	←	←	←	Short–time overload detection time
6624	6919			6764	6959			Conventional : Voltage compensation factor during deceleration
								HRV :
6625	←	←	←	6765	←	←	←	Timer for automatic operation
6626	←	←	←	6766	←	←	←	Velocity command during automatic operation
6627	←	6238	←	6767	←	6418	←	Conventional : Value displayed on load meter at maximum output
								HRV : Value displayed on load meter at maximum output
6628	6922	6239	6268	6768	6962	6419	6448	Conventional : Velocity at which maximum output limit is zero
								HRV : Maximum torque curve compensation coefficient
6629	6923	6240	6269	6769	6963	6420	6449	Conventional : Secondary current factor for rigid tapping
								HRV : Secondary current factor for rigid tapping
6630	6925	6241	6270	6770	6965	6421	6450	Conventional : Compensation factor for phase of electromotive force during deceleration
								HRV : Current loop proportional gain speed coefficient/current phase delay compensation coefficient
6631	←			6771	←			Time constant for velocity detecting filter (in Cs contour control mode)
6632	6928			6772	6968			Current conversion constant for V phase
6633	←	6273	←	6773	←	6453	←	Motor model code

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
6635	←			6775	←			Grid shift in Cs contour control mode
6924	←	←	←	6964	←	←	←	Hysteresis of speed detection level
6926	←			6966	←			Integral gain of velocity loop during cutting feed in Cs contour control mode (HIGH)
6927	←			6967	←			Integral gain of velocity loop during cutting feed in Cs contour control mode (LOW)
6933	←	6313	←	6973	←	6493	←	Current overload alarm detection time constant
6934	6932	6314	6312	6974	6972	6494	6493	Current overload alarm detection level
6935	←	6207	←	6975	←	6387	←	Number of spindle gear teeth (HIGH)
6936	←	6208	←	6976	←	6388	←	Number of position detector gear teeth (HIGH)
6937	←	6209	←	6977	←	6389	←	Number of spindle gear teeth (LOW)
6938	←	6210	←	6978	←	6390	←	Number of position detector gear teeth (LOW)
6211	6215	6216	6217	6391	6395	6396	6397	Time constant for spindle load monitor magnetic flux compensation
6212	6245	6246	6247	6392	6425	6426	6427	Spindle load monitor torque constant
6213	←	6198	←	6393	←	6378	←	Spindle load monitor observer gain 1
6214	←	6199	←	6394	←	6379	←	Spindle load monitor observer gain 2
6276	←	6280	←	6456	←	6460	←	Detection level 2 for completion signal for orientation by position coder
6277	←	6281	←	6457	←	6461	←	Detection level 1 for completion signal for orientation by magnetic sensor
6278	←	6282	←	6458	←	6462	←	Detection level 2 for completion signal for orientation by magnetic sensor
6279	←	6283	←	6459	←	6463	←	Stop position shift in orientation by mag- netic sensor
6284	←	6288	←	6464	←	6468	←	Motor deceleration time constant (HIGH)
6285	←			6465	←			Motor deceleration time constant (MEDIUM HIGH)
6286	←			6466	←			Motor deceleration time constant (MEDIUM LOW)
6287	←	6289	←	6467	←	6469	←	Motor deceleration time constant (LOW)
6290	←	6291	←	6470	←	6471	←	Speed at which deceleration time constant limit starts (HIGH)
6294	←	6295	←	6474	←	6475	←	Speed at which deceleration time constant limit starts (LOW)
6292	←	6293	←	6472	←	6473	←	Command multiplication for spindle orientation by position coder
6298	←	6299	←	6478	←	6479	←	Arbitrary number of velocity detector pulses
6300	←			6480	←			Magnetic flux switching point for calculat- ing acceleration/deceleration time constant during spindle synchronization

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
6301	←	6302	←	6481	←	6482	←	Velocity loop gain speed compensation factor
6303	←	←	←	6483	←	←	←	Torque clamp level
6304	←			6484	←			Bell–shaped acceleration/deceleration time constant during spindle synchronization
6305	←	←	←	6485	←	←	←	Abnormal torque detection level
6306	←	←	←	6486	←	←	←	Advanced feed–forward factor
6309	←	←	←	6489	←	←	←	Spindle motor velocity command detection level
6310	←	←	←	6490	←	←	←	Incomplete integration factor
6311	←			6491	←			Level for detecting speed difference between spindles 1 and 2 during slave operation
6315	←	←	←	6495	←	←	←	Current detection offset compensation

B.2 FOR FANUC Series 15

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3000	←	3320	←	3140	←	3540	←	Bit parameter
3001	←	3321	←	3141	←	3541	←	Bit parameter
3002	←	3322	←	3142	←	3542	←	Bit parameter
3003	←	3323	←	3143	←	3543	←	Bit parameter
3004	←	3324	←	3144	←	3544	←	Bit parameter
3005	←	3325	←	3145	←	3545	←	Bit parameter
3006	←	3326	←	3146	←	3546	←	Bit parameter
3007	←	3327	←	3147	←	3547	←	Bit parameter
3008	←	3328	←	3148	←	3548	←	Bit parameter
3009	←	3329	←	3149	←	3549	←	Bit parameter
3010	←	3330	←	3150	←	3550	←	Bit parameter
3011	←	3331	←	3151	←	3551	←	Bit parameter
3012	←	3332	←	3152	←	3552	←	Bit parameter
3013	←	3333	←	3153	←	3553	←	Bit parameter
3014	←	←	←	3154	←	←	←	Bit parameter
3015	←	←	←	3155	←	←	←	Bit parameter
3016	←	3336	←	3156	←	3556	←	Bit parameter
3017	←	3337	←	3157	←	3557	←	Bit parameter
3018	←	3338	←	3158	←	3558	←	Bit parameter
3019	←	3339	←	3159	←	3559	←	Bit parameter
3020	←	3340	←	3160	←	3560	←	Maximum motor speed
3021	←			3161	←			Maximum speed in Cs contour control mode
3022	←	3341	←	3162	←	3561	←	Speed arrival detection level
3023	←	3342	←	3163	←	3562	←	Speed detection level
3024	←	3343	←	3164	←	3563	←	Speed zero detection level
3025	←	3344	←	3165	←	3564	←	Limited torque
3026	←	3345	←	3166	←	3565	←	Load detection level 1
3027	←	←	←	3167	←	←	←	Load detection level 2
3028	←	3346	←	3168	←	3566	←	Limited output pattern
3029	←	3347	←	3169	←	3567	←	Output limit
3030	←	←	←	3170	←	←	←	Soft start/stop time
3031	←	3348	←	3171	←	3568	←	Stop position in orientation by position coder
3032	←		←	3172	←		←	Acceleration/deceleration time constant during spindle synchronization

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
3033	←			3173	←			Spindle speed to be detected in synchronization
3034	←			3174	←			Shift during synchronous control of spindle phase
3035	←			3175	←			Compensation data for spindle phase synchronization
3036	←	3384	←	3176	←	3604	←	Feed–forward factor
3037	←	3385	←	3177	←	3605	←	Feed–forward factor of velocity loop
3038	←	3349	←	3178	←	3569	←	Spindle orientation speed
3040	←	3350	←	3180	←	3350	←	Proportional gain of velocity loop during normal operation (HIGH)
3041	←	3351	←	3181	←	3351	←	Proportional gain of velocity loop during normal operation (LOW)
3042	←	3352	←	3182	←	3572	←	Proportional gain of velocity loop during orientation (HIGH)
3043	←	3353	←	3183	←	3573	←	Proportional gain of velocity loop during orientation (LOW)
3044	←	3354	←	3184	←	3574	←	Proportional gain of velocity loop in servo mode (HIGH)
3045	←	3355	←	3185	←	3575	←	Proportional gain of velocity loop in servo mode (LOW)
3046	←			3186	←			Proportional gain of velocity loop in Cs contour control mode (HIGH)
3047	←			3187	←			Proportional gain of velocity loop in Cs contour control mode (LOW)
3048	←	3356	←	3188	←	3576	←	Integral gain of velocity loop during normal operation (HIGH)
3049	←	↑	↑	3189	←	↑	↑	Integral gain of velocity loop during normal operation (LOW)
3050	←	3357	←	3190	←	3577	←	Integral gain of velocity loop during orientation (HIGH)
3051	←	↑	↑	3191	←	↑	↑	Integral gain of velocity loop during orientation (LOW)
3052	←	3358	←	3192	←	3578	←	Integral gain of velocity loop in servo mode (HIGH)
3053	←	↑	↑	3193	←	↑	↑	Integral gain of velocity loop in servo mode (LOW)
3054	←			3194	←			Integral gain of velocity loop in Cs contour control mode (HIGH)
3055	←			3195	←			Integral gain of velocity loop in Cs contour control mode (LOW)
3056	←	3360	←	3196	←	3580	←	Gear ratio (HIGH)
3057	←			3197	←			Gear ratio (MEDIUM HIGH)
3058	←			3198	←			Gear ratio (MEDIUM LOW)
3059	←	3361	←	3199	←	3581	←	Gear ratio (LOW)

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3060	←	3362	←	3200	←	3582	←	Position gain during orientation (HIGH)
3061	←			3201	←			Position gain during orientation (MEDIUM HIGH)
3062	←			3202	←			Position gain during orientation (MEDIUM LOW)
3063	←	3363	←	3203	←	3583	←	Position gain during orientation (LOW)
3064	←	3364	←	3204	←	3584	←	Rate of change in position gain upon completion of orientation
3065	←	3365	←	3205	←	3585	←	Position gain in servo mode/during synchronization control (HIGH)
3066	←			3206	←			Position gain in servo mode/during synchronization control (MEDIUM HIGH)
3067	←			3207	←			Position gain in servo mode/during synchronization control (MEDIUM LOW)
3068	←	3366	←	3208	←	3586	←	Position gain in servo mode/during synchronization control (LOW)
3069	←			3209	←			Position gain in Cs contour control mode (HIGH)
3070	←			3210	←			Position gain in Cs contour control mode (MEDIUM HIGH)
3071	←			3211	←			Position gain in Cs contour control mode (MEDIUM LOW)
3072	←			3212	←			Position gain in Cs contour control mode (LOW)
3073	←	3367	←	3213	←	3587	←	Grid shift in servo mode
3074	←			3214	←			Reference position return speed in Cs contour control/servo mode
3075	←	3370	←	3215	←	3590	←	Detection level for orientation completion signal
3076	←	3371	←	3216	←	3591	←	Motor speed limit during orientation
3077	←	3372	←	3217	←	3592	←	Orientation stop position shift
3078	←	3373	←	3218	←	3593	←	MS signal constant
3079	←	3374	←	3219	←	3594	←	MS signal gain adjustment
3080	3310	3375	3451	3220	3530	3595	3671	Conventional : Regenerative power limit
								HRV : Regenerative power limit for high–speed zone/regenerative power limit
3081	←	3376	←	3221	←	3596	←	Delay time until motor power is cut off
3082	←	3377	←	3222	←	3597	←	Setting of acceleration/deceleration time
3083	3280	3380	3428	3223	3500	3600	3648	Motor voltage during normal rotation
3084	←	3381	←	3224	←	3601	←	Motor voltage during orientation
3085	3281	3382	3429	3225	3501	3602	3649	Motor voltage in servo mode/during synchronization control
3086	←			3226	←			Motor voltage in Cs contour control mode
3087	←	←	←	3227	←	←	←	Overspeed level

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3088	←	←	←	3228	←	←	←	Level for detecting excess velocity deviation when motor is restrained
3089	←	←	←	3229	←	←	←	Level for detecting excess velocity deviation when motor rotates
3090	←	←	←	3230	←	←	←	Overload detection level
3091	←	3383	←	3231	←	3603	←	Rate of change in position gain during reference position return in servo mode
3092	←	←	←	3232	←	←	←	Rate of change in position gain during reference position return in Cs contour control mode
3094	←			3234	←			Disturbance torque compensation constant
3095	←	←	←	3235	←	←	←	Adjusted output voltage of speedometer
3096	←	←	←	3236	←	←	←	Adjusted output voltage of load meter
3097	←			3237	←			Feedback gain of spindle speed
3098	←	←	←	3238	←	←	←	Maximum speed of position coder signal detection
3099	←	←	←	3239	←	←	←	Motor activation delay
3100	3282	3400	3430	3240	3502	3620	3650	Conventional : Base speed of motor output specifications
								HRV : Base speed of motor output specifications
3101	3283	3401	3431	3241	3503	3621	3651	Conventional : Output limit for motor output specifications
								HRV : Torque–limit for motor output specifications
3102	3284	3402	3432	3242	3504	3622	3652	Conventional : Base speed
								HRV : Activating voltage saturation speed at no–load
3103	3285	3403	3433	3243	3505	3623	3653	Conventional : Speed at which decrease in magnetic flux begins
								HRV : Base speed limit ratio
3104	3286	3404	3434	3244	3506	3624	3654	Conventional : Proportional gain of current loop
								HRV : Proportional gain of current loop
3105	↑			3245	↑			Conventional : Proportional gain of current loop (in Cs contour control mode)
								HRV :
3106	3287	3405	3435	3246	3507	3625	3655	Conventional : Integral gain of current loop
								HRV : Integral gain of current loop
3107	↑			3247	↑			Conventional : Integral gain of current loop (in Cs contour control mode)
								HRV :

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3108	3288	3406	3436	3248	3508	3626	3656	Conventional : Velocity at which the current loop integral gain is zero
								HRV : Velocity at which the current loop integral gain is zero
3109	3289	3407	3437	3249	3509	3627	3657	Conventional : Velocity factor for proportional gain of current loop
								HRV : Filter time constant for processing saturation related to the voltage command
3110	3290	3408	3438	3250	3510	3628	3658	Conventional : Current conversion constant
								HRV : Current conversion constant
3111	3291	3409	3439	3251	3511	3629	3659	Conventional : Secondary current factor for activating current
								HRV : Secondary current factor
3112	3292	3410	3440	3252	3512	3630	3660	Conventional : Expected–current constant
								HRV : Criterion level for saturation related to the voltage command/PWM command clamp value
3113	3293	3411	3441	3253	3513	3631	3661	Conventional : Slip constant
								HRV : Slip constant
3114	3294	3412	3442	3254	3514	3632	3662	Conventional : Compensation constant for high–speed–rotation slip
								HRV : Slip compensation coefficient for a high–speed zone/slip compensation coefficient at deceleration
3115	3295	3413	3443	3255	3515	3633	3663	Conventional : Compensation constant for voltage applied to motor in dead zone
								HRV : PWM command clamp value at deceleration
3116	3296	3414	3444	3256	3516	3634	3664	Conventional : Compensation constant for electromotive force
								HRV : Motor leakage constant
3117	3297	3415	3445	3257	3517	3635	3665	Conventional : Compensation constant for phase of electromotive force
								HRV : Regular–time voltage compensation coefficient for high–speed zone/regular–time motor voltage coefficient
3118	3298	3416	3446	3258	3518	3636	3666	Conventional : Electromotive force compensation speed factor
								HRV : Acceleration–time voltage compensation coefficient for high–speed zone/acceleration–time motor voltage coefficient

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
3119	3309	3424	3452	3259	3529	3644	3672	Conventional : Time constant for voltage filter for electromotive force compensation
								HRV : Deceleration–time activating current change time constant/activating current change time constant
3120	←	←	←	3260	←	←	←	Conventional : Dead band compensation data
								HRV : Rectangular–wave component zero voltage/current phase delay compensation coefficient
3121	3301	3417	3447	3261	3521	3637	3667	Time constant for changing the torque
3122	←	3422	←	3262	←	3642	←	Time constant for velocity detecting filter
3123	←	←	←	3263	←	←	←	Short–time overload detection time
3124	3299			3264	3519			Conventional : Voltage compensation factor during deceleration
								HRV :
3125	←	←	←	3265	←	←	←	Timer for automatic operation
3126	←	←	←	3266	←	←	←	Velocity command during automatic operation
3127	←	3418	←	3267	←	3638	←	Conventional : Value displayed on load meter at maximum output
								HRV : Value displayed on load meter at maximum output
3128	3302	3419	3448	3268	3522	3639	3668	Conventional : Velocity at which maximum output limit is zero
								HRV : Maximum torque curve compensation coefficient
3129	3303	3420	3449	3269	3523	3640	3669	Conventional : Secondary current factor for rigid tapping
								HRV : Secondary current factor for rigid tapping
3130	3305	3421	3450	3270	3525	3641	3670	Conventional : Compensation factor for phase of electromotive force during deceleration
								HRV : Current loop proportional gain speed coefficient/current phase delay compensation coefficient
3131	←			3271	←			Time constant for velocity detecting filter (in Cs contour control mode)
3132	3308			3272	3528			Current conversion constant for V phase
3133	←	3453	←	3273	←	3673	←	Motor model code
3135	←			3275	←			Grid shift in Cs contour control mode
3304	←	←	←	3524	←	←	←	Hysteresis of speed detection level
3306	←			3526	←			Integral gain of velocity loop during cutting feed in Cs contour control mode (HIGH)

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
3307	←			3527	←			Integral gain of velocity loop during cutting feed in Cs contour control mode (LOW)
3313	←	3493	←	3533	←	3713	←	Current overload alarm detection time constant
3314	3312	3494	3492	3534	3532	3714	3712	Current overload alarm detection level
3315	←	3387	←	3535	←	3607	←	Number of spindle gear teeth (HIGH)
3316	←	3388	←	3536	←	3608	←	Number of position detector gear teeth (HIGH)
3317	←	3389	←	3537	←	3609	←	Number of spindle gear teeth (LOW)
3318	←	3390	←	3538	←	3610	←	Number of position detector gear teeth (LOW)
3391	3395	3396	3397	3611	3615	3616	3617	Time constant for spindle load monitor magnetic flux compensation
3392	3425	3426	3427	3612	3645	3646	3647	Spindle load monitor torque constant
3393	←	3378	←	3613	←	3598	←	Spindle load monitor observer gain 1
3394	←	3379	←	3614	←	3599	←	Spindle load monitor observer gain 2
3456	←	3460	←	3676	←	3680	←	Detection level 2 for completion signal for orientation by position coder
3457	←	3461	←	3677	←	3681	←	Detection level 1 for completion signal for orientation by magnetic sensor
3458	←	3462	←	3678	←	3682	←	Detection level 2 for completion signal for orientation by magnetic sensor
3459	←	3463	←	3679	←	3683	←	Stop position shift in orientation by magnetic sensor
3464	←	3468	←	3684	←	3688	←	Motor deceleration time constant (HIGH)
3465	←			3685	←			Motor deceleration time constant (MEDIUM HIGH)
3466	←			3686	←			Motor deceleration time constant (MEDIUM LOW)
3467	←	3469	←	3687	←	3689	←	Motor deceleration time constant (LOW)
3470	←	3471	←	3690	←	3691	←	Speed at which deceleration time constant limit starts (HIGH)
3474	←	3475	←	3694	←	3695	←	Speed at which deceleration time constant limit starts (LOW)
3472	←	3473	←	3692	←	3693	←	Command multiplication for spindle orientation by position coder
3478	←	3479	←	3698	←	3699	←	Arbitrary number of velocity detector pulses
3480	←			3700	←			Magnetic flux switching point for calculating acceleration/deceleration time constant during spindle synchronization
3481	←	3482	←	3701	←	3702	←	Velocity loop gain speed compensation factor
3483	←	←	←	3703	←	←	←	Torque clamp level

1st spindle				2nd spindle				Contents
Spindle switching MAIN side		Spindle switching SUB side		Spindle switching MAIN side		Spindle switching SUB side		
High–speed charac-teristics	Low–speed charac-teristics	High–speed charac-teristics	Low–speed charac-teristics	High–speed charac-teristics	Low–speed charac-teristics	High–speed charac-teristics	Low–speed charac-teristics	
3484	←			3704	←			Bell–shaped acceleration/deceleration time constant during spindle synchronization
3485	←	←	←	3705	←	←	←	Abnormal torque detection level
3488	←	←	←	3708	←	←	←	Advanced feed–forward factor
3489	←	←	←	3709	←	←	←	Spindle motor velocity command detection level
3490	←	←	←	3710	←	←	←	Incomplete integration factor
3491	←			3711	←			Level for detecting speed difference between spindles 1 and 2 during slave operation
3495	←	←	←	3715	←	←	←	Current detection offset compensation
3719	←			3761	←			MZ sensor signal amplitude ratio compensation (when using the α sensor Cs contour control function)
3720	←			3762	←			MZ sensor signal phase difference compensation (when using the α sensor Cs contour control function)
3721	←			3763	←			BZ sensor signal amplitude ratio compensation (when using the α sensor Cs contour control function)
3722	←			3764	←			BZ sensor signal phase difference compensation (when using the α sensor Cs contour control function)

B.3 FOR FANUC Series 15*i*

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3000	←	3176	←	Bit parameter
3001	←	3177	←	Bit parameter
3002	←	3178	←	Bit parameter
3003	←	3179	←	Bit parameter
3004	←	3180	←	Bit parameter
3005	←	3181	←	Bit parameter
3006	←	3182	←	Bit parameter
3007	←	3183	←	Bit parameter
3008	←	3184	←	Bit parameter
3009	←	3185	←	Bit parameter
3010	←	3186	←	Bit parameter
3011	←	3187	←	Bit parameter
3012	←	3188	←	Bit parameter
3013	←	3189	←	Bit parameter
3014	←	←	←	Bit parameter
3015	←	←	←	Bit parameter
3016	←	3192	←	Bit parameter
3017	←	3193	←	Bit parameter
3018	←	3194	←	Bit parameter
3019	←	3195	←	Bit parameter
3020	←	3196	←	Maximum motor speed
3021	←			Maximum speed in Cs contour control mode
3022	←	3197	←	Speed arrival detection level
3023	←	3198	←	Speed detection level
3024	←	3199	←	Speed zero detection level
3025	←	3200	←	Limited torque
3026	←	3201	←	Load detection level 1
3027	←	←	←	Load detection level 2
3028	←	3202	←	Limited output pattern
3029	←	3203	←	Output limit
3030	←	←	←	Soft start/stop time
3031	←	3204	←	Stop position in orientation by position coder
3032	←		←	Acceleration/deceleration time constant during spindle synchronization

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
3033	←			Spindle speed to be detected in synchronization
3034	←			Shift during synchronous control of spindle phase
3035	←			Compensation data for spindle phase synchronization
3036	←	3240	←	Feed–forward factor
3037	←	3241	←	Feed–forward factor of velocity loop
3038	←	3205	←	Spindle orientation speed
3040	←	3206	←	Proportional gain of velocity loop during normal operation (HIGH)
3041	←	3207	←	Proportional gain of velocity loop during normal operation (LOW)
3042	←	3208	←	Proportional gain of velocity loop during orientation (HIGH)
3043	←	3209	←	Proportional gain of velocity loop during orientation (LOW)
3044	←	3210	←	Proportional gain of velocity loop in servo mode (HIGH)
3045	←	3211	←	Proportional gain of velocity loop in servo mode (LOW)
3046	←			Proportional gain of velocity loop in Cs contour control mode (HIGH)
3047	←			Proportional gain of velocity loop in Cs contour control mode (LOW)
3048	←	3212	←	Integral gain of velocity loop during normal operation (HIGH)
3049	←	↑	↑	Integral gain of velocity loop during normal operation (LOW)
3050	←	3213	←	Integral gain of velocity loop during orientation (HIGH)
3051	←	↑	↑	Integral gain of velocity loop during orientation (LOW)
3052	←	3214	←	Integral gain of velocity loop in servo mode (HIGH)
3053	←	↑	↑	Integral gain of velocity loop in servo mode (LOW)
3054	←			Integral gain of velocity loop in Cs contour control mode (HIGH)
3055	←			Integral gain of velocity loop in Cs contour control mode (LOW)
3056	←	3216	←	Gear ratio (HIGH)
3057	←			Gear ratio (MEDIUM HIGH)
3058	←			Gear ratio (MEDIUM LOW)
3059	←	3217	←	Gear ratio (LOW)
3060	←	3218	←	Position gain during orientation (HIGH)

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3061	←			Position gain during orientation (MEDIUM HIGH)
3062	←			Position gain during orientation (MEDIUM LOW)
3063	←	3219	←	Position gain during orientation (LOW)
3064	←	3220	←	Rate of change in position gain upon completion of orientation
3065	←	3221	←	Position gain in servo mode/during syn- chronization control (HIGH)
3066	←			Position gain in servo mode/during syn- chronization control (MEDIUM HIGH)
3067	←			Position gain in servo mode/during syn- chronization control (MEDIUM LOW)
3068	←	3222	←	Position gain in servo mode/during syn- chronization control (LOW)
3069	←			Position gain in Cs contour control mode (HIGH)
3070	←			Position gain in Cs contour control mode (MEDIUM HIGH)
3071	←			Position gain in Cs contour control mode (MEDIUM LOW)
3072	←			Position gain in Cs contour control mode (LOW)
3073	←	3223	←	Grid shift in servo mode
3074	←			Reference position return speed in Cs contour control/servo mode
3075	←	3226	←	Detection level for orientation completion signal
3076	←	3227	←	Motor speed limit during orientation
3077	←	3228	←	Orientation stop position shift
3078	←	3229	←	MS signal constant
3079	←	3230	←	MS signal gain adjustment
3080	3166	3231	3307	Conventional : Regenerative power limit
				HRV : Regenerative power limit for high–speed zone/regenerative power limit
3081	←	3232	←	Delay time until motor power is cut off
3082	←	3233	←	Setting of acceleration/deceleration time
3083	3136	3236	3284	Motor voltage during normal rotation
3084	←	3237	←	Motor voltage during orientation
3085	3137	3238	3285	Motor voltage in servo mode/during syn- chronization control
3086	←			Motor voltage in Cs contour control mode
3087	←	←	←	Overspeed level
3088	←	←	←	Level for detecting excess velocity devi- ation when motor is restrained

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac-teristics	**Low –speed charac-teristics**	**High –speed charac-teristics**	**Low –speed charac-teristics**	
3089	←	←	←	Level for detecting excess velocity deviation when motor rotates
3090	←	←	←	Overload detection level
3091	←	3239	←	Rate of change in position gain during reference position return in servo mode
3092	←	←	←	Rate of change in position gain during reference position return in Cs contour control mode
3094	←			Disturbance torque compensation constant
3095	←	←	←	Adjusted output voltage of speedometer
3096	←	←	←	Adjusted output voltage of load meter
3097	←			Feedback gain of spindle speed
3098	←	←	←	Maximum speed of position coder signal detection
3099	←	←	←	Motor activation delay
3100	3138	3256	3286	Conventional : Base speed of motor output specifications
				HRV : Base speed of motor output specifications
3101	3139	3257	3287	Conventional : Output limit for motor output specifications
				HRV : Torque–limit for motor output specifications
3102	3140	3258	3288	Conventional : Base speed
				HRV : Activating voltage saturation speed at no–load
3103	3141	3259	3289	Conventional : Speed at which decrease in magnetic flux begins
				HRV : Base speed limit ratio
3104	3142	3260	3290	Conventional : Proportional gain of current loop
				HRV : Proportional gain of current loop
3105	↑			Conventional : Proportional gain of current loop (in Cs contour control mode)
				HRV :
3106	3143	3261	3291	Conventional : Integral gain of current loop
				HRV : Integral gain of current loop
3107	↑			Conventional : Integral gain of current loop (in Cs contour control mode)
				HRV :
3108	3144	3262	3292	Conventional : Velocity at which the current loop integral gain is zero
				HRV : Velocity at which the current loop integral gain is zero

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3109	3145	3263	3293	Conventional : Velocity factor for proportional gain of current loop
				HRV : Filter time constant for processing saturation related to the voltage command
3110	3146	3264	3294	Conventional : Current conversion constant
				HRV : Current conversion constant
3111	3147	3265	3295	Conventional : Secondary current factor for activating current
				HRV : Secondary current factor
3112	3148	3266	3296	Conventional : Expected–current constant
				HRV : Criterion level for saturation related to the voltage command/PWM command clamp value
3113	3149	3267	3297	Conventional : Slip constant
				HRV : Slip constant
3114	3150	3268	3298	Conventional : Compensation constant for high–speed–rotation slip
				HRV : Slip compensation coefficient for a high–speed zone/slip compensation coefficient at deceleration
3115	3151	3269	3299	Conventional : Compensation constant for voltage applied to motor in dead zone
				HRV : PWM command clamp value at deceleration
3116	3152	3270	3300	Conventional : Compensation constant for electromotive force
				HRV : Motor leakage constant
3117	3153	3271	3301	Conventional : Compensation constant for phase of electromotive force
				HRV : Regular–time voltage compensation coefficient for high–speed zone/regular–time motor voltage coefficient
3118	3154	3272	3302	Conventional : Electromotive force compensation speed factor
				HRV : Acceleration–time voltage compensation coefficient for high–speed zone/acceleration–time motor voltage coefficient
3119	3165	3280	3308	Conventional : Time constant for voltage filter for electromotive force compensation
				HRV : Deceleration–time activating current change time constant/activating current change time constant
3120	←	←	←	Conventional : Dead band compensation data
				HRV : Rectangular–wave component zero voltage/dead–zone compensation data

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3121	3157	3273	3303	Time constant for changing the torque
3122	←	3278	←	Time constant for velocity detecting filter
3123	←	←	←	Short–time overload detection time
3124	3155			Conventional : Voltage compensation factor during deceleration
				HRV :
3125	←	←	←	Timer for automatic operation
3126	←	←	←	Velocity command during automatic operation
3127	←	3274	←	Conventional : Value displayed on load meter at maximum output
				HRV : Value displayed on load meter at maximum output
3128	3158	3275	3304	Conventional : Velocity at which maximum output limit is zero
				HRV : Maximum torque curve compensation coefficient
3129	3159	3276	3305	Conventional : Secondary current factor for rigid tapping
				HRV : Secondary current factor for rigid tapping
3130	3161	3277	3306	Conventional : Compensation factor for phase of electromotive force during deceleration
				HRV : Current loop proportional gain speed coefficient/current phase delay compensation coefficient
3131	←			Time constant for velocity detecting filter (in Cs contour control mode)
3132	3164			Current conversion constant for V phase
3133	←	3309	←	Motor model code
3135	←			Grid shift in Cs contour control mode
3160	←	←	←	Hysteresis of speed detection level
3162	←			Integral gain of velocity loop during cutting feed in Cs contour control mode (HIGH)
3163	←			Integral gain of velocity loop during cutting feed in Cs contour control mode (LOW)
3169	←	3349	←	Current overload alarm detection time constant
3170	3168	3350	3348	Current overload alarm detection level
3171	←	3243	←	Number of spindle gear teeth (HIGH)
3172	←	3244	←	Number of position detector gear teeth (HIGH)
3173	←	3245	←	Number of spindle gear teeth (LOW)
3174	←	3246	←	Number of position detector gear teeth (LOW)

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed characteristics	Low –speed characteristics	High –speed characteristics	Low –speed characteristics	
3247	3251	3252	3253	Time constant for spindle load monitor magnetic flux compensation
3248	3281	3282	3283	Spindle load monitor torque constant
3249	←	3234	←	Spindle load monitor observer gain 1
3250	←	3235	←	Spindle load monitor observer gain 2
3312	←	3316	←	Detection level 2 for completion signal for orientation by position coder
3313	←	3317	←	Detection level 1 for completion signal for orientation by magnetic sensor
3314	←	3318	←	Detection level 2 for completion signal for orientation by magnetic sensor
3315	←	3319	←	Stop position shift in orientation by magnetic sensor
3320	←	3324	←	Motor deceleration time constant (HIGH)
3321	←			Motor deceleration time constant (MEDIUM HIGH)
3322	←			Motor deceleration time constant (MEDIUM LOW)
3323	←	3325	←	Motor deceleration time constant (LOW)
3326	←	3327	←	Speed at which deceleration time constant limit starts (HIGH)
3330	←	3331	←	Speed at which deceleration time constant limit starts (LOW)
3328	←	3329	←	Command multiplication for spindle orientation by position coder
3334	←	3335	←	Arbitrary number of velocity detector pulses
3336	←			Magnetic flux switching point for calculating acceleration/deceleration time constant during spindle synchronization
3337	←	3338	←	Velocity loop gain speed compensation factor
3339	←	←	←	Torque clamp level
3340	←			Bell–shaped acceleration/deceleration time constant during spindle synchronization
3341	←	←	←	Abnormal torque detection level
3344	←	←	←	Advanced feed–forward factor
3345	←	←	←	Spindle motor velocity command detection level
3346	←	←	←	Incomplete integration factor
3347	←			Level for detecting speed difference between spindles 1 and 2 during slave operation
3351	←	←	←	Current detection offset compensation

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
3355	←			MZ sensor signal amplitude ratio compensation (when using the α sensor Cs contour control function)
3356	←			MZ sensor signal phase difference compensation (when using the α sensor Cs contour control function)
3357	←			BZ sensor signal amplitude ratio compensation (when using the α sensor Cs contour control function)
3358	←			BZ sensor signal phase difference compensation (when using the α sensor Cs contour control function)

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Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
4000	←	4176	←	Bit parameter
4001	←	4177	←	Bit parameter
4002	←	4178	←	Bit parameter
4003	←	4179	←	Bit parameter
4004	←	4180	←	Bit parameter
4005	←	4181	←	Bit parameter
4006	←	4182	←	Bit parameter
4007	←	4183	←	Bit parameter
4008	←	4184	←	Bit parameter
4009	←	4185	←	Bit parameter
4010	←	4186	←	Bit parameter
4011	←	4187	←	Bit parameter
4012	←	4188	←	Bit parameter
4013	←	4189	←	Bit parameter
4014	←	←	←	Bit parameter
4015	←	←	←	Bit parameter
4016	←	4192	←	Bit parameter
4017	←	4193	←	Bit parameter
4018	←	4194	←	Bit parameter
4019	←	4195	←	Bit parameter
4020	←	4196	←	Maximum motor speed
4021	←			Maximum speed in Cs contour control mode
4022	←	4197	←	Speed arrival detection level
4023	←	4198	←	Speed detection level
4024	←	4199	←	Speed zero detection level
4025	←	4200	←	Limited torque
4026	←	4201	←	Load detection level 1
4027	←	←	←	Load detection level 2
4028	←	4202	←	Limited output pattern
4029	←	4203	←	Output limit
4030	←	←	←	Soft start/stop time
4031	←	4204	←	Stop position in orientation by position coder
4032	←		←	Acceleration/deceleration time constant during spindle synchronization

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
4033	←			Spindle speed to be detected in synchronization
4034	←			Shift during synchronous control of spindle phase
4035	←			Compensation data for spindle phase synchronization
4036	←	4240	←	Feed–forward factor
4037	←	4241	←	Feed–forward factor of velocity loop
4038	←	4205	←	Spindle orientation speed
4040	←	4206	←	Proportional gain of velocity loop during normal operation (HIGH)
4041	←	4207	←	Proportional gain of velocity loop during normal operation (LOW)
4042	←	4208	←	Proportional gain of velocity loop during orientation (HIGH)
4043	←	4209	←	Proportional gain of velocity loop during orientation (LOW)
4044	←	4210	←	Proportional gain of velocity loop in servo mode (HIGH)
4045	←	4211	←	Proportional gain of velocity loop in servo mode (LOW)
4046	←			Proportional gain of velocity loop in Cs contour control mode (HIGH)
4047	←			Proportional gain of velocity loop in Cs contour control mode (LOW)
4048	←	4212	←	Integral gain of velocity loop during normal operation (HIGH)
4049	←	↑	↑	Integral gain of velocity loop during normal operation (LOW)
4050	←	4213	←	Integral gain of velocity loop during orientation (HIGH)
4051	←	↑	↑	Integral gain of velocity loop during orientation (LOW)
4052	←	4214	←	Integral gain of velocity loop in servo mode (HIGH)
4053	←	↑	↑	Integral gain of velocity loop in servo mode (LOW)
4054	←			Integral gain of velocity loop in Cs contour control mode (HIGH)
4055	←			Integral gain of velocity loop in Cs contour control mode (LOW)
4056	←	4216	←	Gear ratio (HIGH)
4057	←			Gear ratio (MEDIUM HIGH)
4058	←			Gear ratio (MEDIUM LOW)
4059	←	4217	←	Gear ratio (LOW)
4060	←	4218	←	Position gain during orientation (HIGH)

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac- teristics	Low –speed charac- teristics	High –speed charac- teristics	Low –speed charac- teristics	
4061	←			Position gain during orientation (MEDIUM HIGH)
4062	←			Position gain during orientation (MEDIUM LOW)
4063	←	4219	←	Position gain during orientation (LOW)
4064	←	4220	←	Rate of change in position gain upon completion of orientation
4065	←	4221	←	Position gain in servo mode/during syn- chronization control (HIGH)
4066	←			Position gain in servo mode/during syn- chronization control (MEDIUM HIGH)
4067	←			Position gain in servo mode/during syn- chronization control (MEDIUM LOW)
4068	←	4222	←	Position gain in servo mode/during syn- chronization control (LOW)
4069	←			Position gain in Cs contour control mode (HIGH)
4070	←			Position gain in Cs contour control mode (MEDIUM HIGH)
4071	←			Position gain in Cs contour control mode (MEDIUM LOW)
4072	←			Position gain in Cs contour control mode (LOW)
4073	←	4223	←	Grid shift in servo mode
4074	←			Reference position return speed in Cs contour control/servo mode
4075	←	4226	←	Detection level for orientation completion signal
4076	←	4227	←	Motor speed limit during orientation
4077	←	4228	←	Orientation stop position shift
4078	←	4229	←	MS signal constant
4079	←	4230	←	MS signal gain adjustment
4080	4166	4231	4307	Conventional : Regenerative power limit
				HRV : Regenerative power limit for high–speed zone/regenerative power limit
4081	←	4232	←	Delay time until motor power is cut off
4082	←	4233	←	Setting of acceleration/deceleration time
4083	4136	4236	4284	Motor voltage during normal rotation
4084	←	4237	←	Motor voltage during orientation
4085	4137	4238	4285	Motor voltage in servo mode/during syn- chronization control
4086	←			Motor voltage in Cs contour control mode
4087	←	←	←	Overspeed level
4088	←	←	←	Level for detecting excess velocity devi- ation when motor is restrained

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
4089	←	←	←	Level for detecting excess velocity deviation when motor rotates
4090	←	←	←	Overload detection level
4091	←	4239	←	Rate of change in position gain during reference position return in servo mode
4092	←	←	←	Rate of change in position gain during reference position return in Cs contour control mode
4094	←			Disturbance torque compensation constant
4095	←	←	←	Adjusted output voltage of speedometer
4096	←	←	←	Adjusted output voltage of load meter
4097	←			Feedback gain of spindle speed
4098	←	←	←	Maximum speed of position coder signal detection
4099	←	←	←	Motor activation delay
4100	4138	4256	4286	Conventional : Base speed of motor output specifications
				HRV : Base speed of motor output specifications
4101	4139	4257	4287	Conventional : Output limit for motor output specifications
				HRV : Torque–limit for motor output specifications
4102	4140	4258	4288	Conventional : Base speed
				HRV : Activating voltage saturation speed at no–load
4103	4141	4259	4289	Conventional : Speed at which decrease in magnetic flux begins
				HRV : Base speed limit ratio
4104	4142	4260	4290	Conventional : Proportional gain of current loop
				HRV : Proportional gain of current loop
4105	↑			Conventional : Proportional gain of current loop (in Cs contour control mode)
				HRV :
4106	4143	4261	4291	Conventional : Integral gain of current loop
				HRV : Integral gain of current loop
4107	↑			Conventional : Integral gain of current loop (in Cs contour control mode)
				HRV :
4108	4144	4262	4292	Conventional : Velocity at which the current loop integral gain is zero
				HRV : Velocity at which the current loop integral gain is zero

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed characteristics	Low –speed characteristics	High –speed characteristics	Low –speed characteristics	
4109	4145	4263	4293	Conventional : Velocity factor for proportional gain of current loop
				HRV : Filter time constant for processing saturation related to the voltage command
4110	4146	4264	4294	Conventional : Current conversion constant
				HRV : Current conversion constant
4111	4147	4265	4295	Conventional : Secondary current factor for activating current
				HRV : Secondary current factor
4112	4148	4266	4296	Conventional : Expected–current constant
				HRV : Criterion level for saturation related to the voltage command/PWM command clamp value
4113	4149	4267	4297	Conventional : Slip constant
				HRV : Slip constant
4114	4150	4268	4298	Conventional : Compensation constant for high–speed–rotation slip
				HRV : Slip compensation coefficient for a high–speed zone/slip compensation coefficient at deceleration
4115	4151	4269	4299	Conventional : Compensation constant for voltage applied to motor in dead zone
				HRV : PWM command clamp value at deceleration
4116	4152	4270	4300	Conventional : Compensation constant for electromotive force
				HRV : Motor leakage constant
4117	4153	4271	4301	Conventional : Compensation constant for phase of electromotive force
				HRV : Regular–time voltage compensation coefficient for high–speed zone/regular–time motor voltage coefficient
4118	4154	4272	4302	Conventional : Electromotive force compensation speed factor
				HRV : Acceleration–time voltage compensation coefficient for high–speed zone/acceleration–time motor voltage coefficient
4119	4165	4280	4308	Conventional : Time constant for voltage filter for electromotive force compensation
				HRV : Deceleration–time activating current change time constant/activating current change time constant
4120	←	←	←	Conventional : Dead band compensation data
				HRV : Rectangular–wave component zero voltage/dead–zone compensation data

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
4121	4157	4273	4303	Time constant for changing the torque
4122	←	4278	←	Time constant for velocity detecting filter
4123	←	←	←	Short–time overload detection time
4124	4155			Conventional : Voltage compensation factor during deceleration
				HRV :
4125	←	←	←	Timer for automatic operation
4126	←	←	←	Velocity command during automatic operation
4127	←	4274	←	Conventional : Value displayed on load meter at maximum output
				HRV : Value displayed on load meter at maximum output
4128	4158	4275	4304	Conventional : Velocity at which maximum output limit is zero
				HRV : Maximum torque curve compensation coefficient
4129	4159	4276	4305	Conventional : Secondary current factor for rigid tapping
				HRV : Secondary current factor for rigid tapping
4130	4161	4277	4306	Conventional : Compensation factor for phase of electromotive force during deceleration
				HRV : Current loop proportional gain speed coefficient/current phase delay compensation coefficient
4131	←			Time constant for velocity detecting filter (in Cs contour control mode)
4132	4164			Current conversion constant for V phase
4133	←	4309	←	Motor model code
4135	←			Grid shift in Cs contour control mode
4160	←	←	←	Hysteresis of speed detection level
4162	←			Integral gain of velocity loop during cutting feed in Cs contour control mode (HIGH)
4163	←			Integral gain of velocity loop during cutting feed in Cs contour control mode (LOW)
4169	←	4349	←	Current overload alarm detection time constant
4170	4168	4350	4348	Current overload alarm detection level
4171	←	4243	←	Number of spindle gear teeth (HIGH)
4172	←	4244	←	Number of position detector gear teeth (HIGH)
4173	←	4245	←	Number of spindle gear teeth (LOW)
4174	←	4246	←	Number of position detector gear teeth (LOW)

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
4247	4251	4252	4253	Time constant for spindle load monitor magnetic flux compensation
4248	4281	4282	4283	Spindle load monitor torque constant
4249	←	4234	←	Spindle load monitor observer gain 1
4250	←	4235	←	Spindle load monitor observer gain 2
4312	←	4316	←	Detection level 2 for completion signal for orientation by position coder
4313	←	4317	←	Detection level 1 for completion signal for orientation by magnetic sensor
4314	←	4318	←	Detection level 2 for completion signal for orientation by magnetic sensor
4315	←	4319	←	Stop position shift in orientation by magnetic sensor
4320	←	4324	←	Motor deceleration time constant (HIGH)
4321	←			Motor deceleration time constant (MEDIUM HIGH)
4322	←			Motor deceleration time constant (MEDIUM LOW)
4323	←	4325	←	Motor deceleration time constant (LOW)
4326	←	4327	←	Speed at which deceleration time constant limit starts (HIGH)
4330	←	4331	←	Speed at which deceleration time constant limit starts (LOW)
4328	←	4329	←	Command multiplication for spindle orientation by position coder
4334	←	4335	←	Arbitrary number of velocity detector pulses
4336	←			Magnetic flux switching point for calculating acceleration/deceleration time constant during spindle synchronization
4337	←	4338	←	Velocity loop gain speed compensation factor
4339	←	←	←	Torque clamp level
4340	←			Bell–shaped acceleration/deceleration time constant during spindle synchronization
4341	←	←	←	Abnormal torque detection level
4344	←	←	←	Advanced feed–forward factor
4345	←	←	←	Spindle motor velocity command detection level
4346	←	←	←	Incomplete integration factor
4347	←			Level for detecting speed difference between spindles 1 and 2 during slave operation
4351	←	←	←	Current detection offset compensation

Spindle switching MAIN side		Spindle switching SUB side		Contents
High –speed charac-teristics	Low –speed charac-teristics	High –speed charac-teristics	Low –speed charac-teristics	
4355	←			MZ sensor signal amplitude ratio compensation (when using the α sensor Cs contour control function)
4356	←			MZ sensor signal phase difference compensation (when using the α sensor Cs contour control function)
4357	←			BZ sensor signal amplitude ratio compensation (when using the α sensor Cs contour control function)
4358	←			BZ sensor signal phase difference compensation (when using the α sensor Cs contour control function)

C TABLE OF PARAMETERS FOR EACH MOTOR MODEL

C.1 SPINDLE MOTOR α Series

Motor model name				α0.5	α1	α1/15000	α1 (IP55)	α1.5	α1.5 (IP55)
Applicable amplifier				SPM–2.2	SPM–2.2	SPM–2.2	SPM–2.2	SPM–5.5	SPM–5.5
Model code (applicable software)				100 (9D00/O)	101(9D00/G)	–	–	102 (9D00/G)	–
Output specifications / Parameter No.				0.55/1.1 kW 3000/8000 min^{-1}	1.5/2.2 kW 3000/8000 min^{-1}	1.5/2.2 kW 3000/15000 min^{-1}	0.9/2.2kW 3000/8000 min^{-1}	1.1/3.7 kW 1500/8000 min^{-1}	0.9/3.7 kW 1500/8000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	←	←	10000000	←
6508	3008	3008	4008	00000000	00000000	←	←	00000000	←
6509	3009	3009	4009	00000000	00000000	←	←	00000000	←
6511	3011	3011	4011	00001000	00001001	←	←	00001001	←
6512	3012	3012	4012	00000000	00000000	←	←	00000000	←
6513	3013	3013	4013	00011010	00011010	←	←	00011010	←
6519	3019	3019	4019	00001100	00001100	←	←	00001100	←
6520	3020	3020	4020	8000	8000	15000*	8000	8000	←
6539	3039	3039	4039	0	0	←	←	0	←
6580	3080	3080	4080	100	60	←	←	60	←
6600	3100	3100	4100	3000	3000	←	←	1500	←
6601	3101	3101	4101	100	100	←	←	100	←
6602	3102	3102	4102	5500	3000	←	←	2000	←
6603	3103	3103	4103	5500	3000	←	←	2000	←
6604	3104	3104	4104	500	1500	←	←	1500	←
6605	3105	3105	4105	500	1500	←	←	1500	←
6606	3106	3106	4106	1500	1500	←	←	1500	←
6607	3107	3107	4107	1500	1500	←	←	1500	←
6608	3108	3108	4108	300	500	←	←	500	←
6609	3109	3109	4109	10	10	←	←	10	←
6610	3110	3110	4110	2155	629	←	←	377	←
6611	3111	3111	4111	26	8	←	←	13	←
6612	3112	3112	4112	652	652	←	←	652	←
6613	3113	3113	4113	1000	1550	←	←	1600	←
6614	3114	3114	4114	10	10	←	←	10	←
6615	3115	3115	4115	5	3	←	←	2	←
6616	3116	3116	4116	100	100	←	←	100	←
6617	3117	3117	4117	20	20	←	←	20	←
6618	3118	3118	4118	20	10	←	←	10	←
6619	3119	3119	4119	0	0	←	←	0	←
6620	3120	3120	4120	20	40	←	←	40	←
6624	3124	3124	4124	0	0	←	←	0	←
6627	3127	3127	4127	240	176	←	293*	403	493*
6628	3128	3128	4128	0	0	←	←	16000	←
6629	3129	3129	4129	0	0	←	←	0	←
6630	3130	3130	4130	95	0	←	←	0	←
6933	3313	3169	4169	0	0	←	←	0	←

Motor model name				α2	α2/10000	α2 (IP55)	α2/15000	α3	α3/12000
Applicable amplifier				SPM–5.5	SPM–5.5	SPM–5.5	SPM–5.5	SPM–5.5	SPM–5.5
Model code (applicable software)				103 (9D00/G)	–	–	104(9D00/G)	105 (9D00/G)	–
Output specifications / Parameter No.				2.2/3.7 kW 1500/8000 min^{-1}	2.2/3.7 kW 1500/10000 min^{-1}	1.5/3.7 kW 1500/10000 min^{-1}	2.2/3.7 kW 3000/15000 min^{-1}	3.7/5.5 kW 1500/8000 min^{-1}	3.7/5.5 kW 1500/8000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	←	←	10000000	10000000	←
6508	3008	3008	4008	00000000	←	←	00000000	00000001	←
6509	3009	3009	4009	100000	←	←	00000000	00000000	←
6511	3011	3011	4011	00001001	←	←	00001001	00001001	←
6512	3012	3012	4012	00000000	←	←	00000000	00000000	←
6513	3013	3013	4013	00011010	←	←	00011010	00011010	←
6519	3019	3019	4019	00001100	←	←	00001100	00001100	←
6520	3020	3020	4020	8000	10000*	8000	15000	8000	12000*
6539	3039	3039	4039	0	←	←	0	160	←
6580	3080	3080	4080	70	←	←	95	55	←
6600	3100	3100	4100	1750	←	←	3750	1550	←
6601	3101	3101	4101	100	←	←	100	100	←
6602	3102	3102	4102	2352	←	←	4500	1550	←
6603	3103	3103	4103	2352	←	←	4500	1450	←
6604	3104	3104	4104	1300	←	←	400	1800	←
6605	3105	3105	4105	1300	←	←	400	1800	←
6606	3106	3106	4106	1500	←	←	1500	1500	←
6607	3107	3107	4107	1500	←	←	1500	1500	←
6608	3108	3108	4108	300	←	←	300	300	←
6609	3109	3109	4109	10	←	←	10	10	←
6610	3110	3110	4110	585	←	←	548	475	←
6611	3111	3111	4111	22	←	←	17	20	←
6612	3112	3112	4112	783	←	←	587	1696	←
6613	3113	3113	4113	450	←	←	400	400	←
6614	3114	3114	4114	10	←	←	20	20	←
6615	3115	3115	4115	2	←	←	3	3	←
6616	3116	3116	4116	100	←	←	100	115	←
6617	3117	3117	4117	20	←	←	20	20	←
6618	3118	3118	4118	10	←	←	0	30	←
6619	3119	3119	4119	0	←	←	0	0	←
6620	3120	3120	4120	35	←	←	35	30	←
6624	3124	3124	4124	0	←	←	0	0	←
6627	3127	3127	4127	202	←	296*	202	178	←
6628	3128	3128	4128	10000	←	←	20000	0	←
6629	3129	3129	4129	0	←	←	0	0	←
6630	3130	3130	4130	0	←	←	0	0	←
6933	3313	3169	4169	0	←	←	0	2700	←

Motor model name				α3(IP55)	α5	α5/12000	α8	α8/8000	
Applicable amplifier				SPM–5.5	SPM–11	SPM–11	SPM–11	SPM–11	
Model code (applicable software)				105 (9D00/G)	106 (9D00/G)	–	107(9D00/G)	–	
Output specifications / Parameter No.				2.2/5.5 kW 1500/6000 min^{-1}	5.5/7.5 kW 1500/8000 min^{-1}	5.5/7.5 kW 1500/12000 min^{-1}	7.5/11 kW 1500/6000 min^{-1}	7.5/11 kW 1500/6000 min^{-1}	
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	←	10000000	←	
6508	3008	3008	4008	00000001	00000001	←	00000001	←	
6509	3009	3009	4009	00000000	00000000	←	00000000	←	
6511	3011	3011	4011	00001001	00001010	00001001*	00001010	←	
6512	3012	3012	4012	00000000	00000000	←	00000000	←	
6513	3013	3013	4013	00011010	00011010	←	00011010	←	
6519	3019	3019	4019	00001100	00001100	←	00001100	←	
6520	3020	3020	4020	6000*	8000	12000*	6000	8000*	
6539	3039	3039	4039	160	0	←	0	←	
6580	3080	3080	4080	55	60	50*	65	←	
6600	3100	3100	4100	1550	1500	←	1590	←	
6601	3101	3101	4101	100	100	←	100	←	
6602	3102	3102	4102	1550	1730	←	1590	←	
6603	3103	3103	4103	1450	1730	←	1590	←	
6604	3104	3104	4104	1800	1500	←	1500	←	
6605	3105	3105	4105	1800	1500	←	1500	←	
6606	3106	3106	4106	1500	1500	←	1500	←	
6607	3107	3107	4107	1500	1500	←	1500	←	
6608	3108	3108	4108	300	300	←	300	←	
6609	3109	3109	4109	10	10	←	10	←	
6610	3110	3110	4110	475	629	←	503	←	
6611	3111	3111	4111	20	17	←	20	←	
6612	3112	3112	4112	1696	1000	←	1000	←	
6613	3113	3113	4113	400	450	←	400	←	
6614	3114	3114	4114	20	10	←	20	←	
6615	3115	3115	4115	3	5	←	5	←	
6616	3116	3116	4116	115	100	←	100	←	
6617	3117	3117	4117	20	20	←	20	←	
6618	3118	3118	4118	30	30	←	30	←	
6619	3119	3119	4119	0	0	←	0	←	
6620	3120	3120	4120	30	38	←	40	←	
6624	3124	3124	4124	0	0	←	0	←	
6627	3127	3127	4127	300*	164	←	176	←	
6628	3128	3128	4128	0	7000	←	0	←	
6629	3129	3129	4129	0	0	←	0	←	
6630	3130	3130	4130	0	0	←	0	←	
6933	3313	3169	4169	2700	0	←	0	←	

Motor model name				α12	α12/8000	α15	α15/8000	α18	α18/8000
Applicable amplifier				SPM–15	SPM–15	SPM–22	SPM–22	SPM–22	SPM–22
Model code (applicable software)				108(9D00/G)	–	109 (9D00/G)	–	110(9D00/G)	–
Output specifications / Parameter No.				11/15 kW 1500/6000 min^{-1}	11/15 kW 1500/8000 min^{-1}	15/18.5 kW 1500/6000 min^{-1}	15/18.5 kW 1500/8000 min^{-1}	18.5/22 kW 1500/6000 min^{-1}	18.5/22 kW 1500/8000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	←	10000000	←	10000000	←
6508	3008	3008	4008	00000001	←	00000001	←	00000001	←
6509	3009	3009	4009	00000000	←	00000000	←	00000000	←
6511	3011	3011	4011	00001010	←	00001010	←	00001010	←
6512	3012	3012	4012	00000000	←	00000000	←	00000000	←
6513	3013	3013	4013	0011010	←	00100110	←	00100110	←
6519	3019	3019	4019	00001100	←	00001100	←	00001100	←
6520	3020	3020	4020	6000	8000*	6000	8000*	6000	8000*
6539	3039	3039	4039	0	←	150	←	0	←
6580	3080	3080	4080	50	←	70	←	60	←
6600	3100	3100	4100	1500	←	1600	←	1600	←
6601	3101	3101	4101	100	←	100	←	100	←
6602	3102	3102	4102	1500	←	1600	←	1600	←
6603	3103	3103	4103	1500	←	1600	←	1600	←
6604	3104	3104	4104	1300	←	1300	←	1300	←
6605	3105	3105	4105	1300	←	1300	←	1300	←
6606	3106	3106	4106	1200	←	1200	←	1200	←
6607	3107	3107	4107	1200	←	1200	←	1200	←
6608	3108	3108	4108	500	←	300	←	300	←
6609	3109	3109	4109	10	←	10	←	10	←
6610	3110	3110	4110	870	←	862	←	616	←
6611	3111	3111	4111	27	←	26	←	25	←
6612	3112	3112	4112	333	←	500	←	500	←
6613	3113	3113	4113	160	←	160	←	140	←
6614	3114	3114	4114	16	←	18	←	15	←
6615	3115	3115	4115	9	←	10	←	5	←
6616	3116	3116	4116	100	←	100	←	106	←
6617	3117	3117	4117	20	←	20	←	20	←
6618	3118	3118	4118	30	←	25	←	30	←
6619	3119	3119	4119	0	←	0	←	0	←
6620	3120	3120	4120	40	←	50	←	50	←
6624	3124	3124	4124	0	←	0	←	0	←
6627	3127	3127	4127	164	←	148	←	143	←
6628	3128	3128	4128	0	←	0	←	0	←
6629	3129	3129	4129	0	←	0	←	0	←
6630	3130	3130	4130	0	←	0	←	0	←
6933	3313	3169	4169	0	←	3600	←	0	←

Motor model name				α22	α22/8000	α30	α40 (0868)	α40 (0861)	
Applicable amplifier				SPM–26	SPM–26	SPM–45	SPM–45	SPM–45	
Model code (applicable software)				111 (9D00/G)	–	125 (9D0A/A)	126 (9D0A/A)	–	
Output specifications / Parameter No.				2.2/5.5 kW 1500/6000 min^{-1}	5.5/7.5 kW 1500/8000 min^{-1}	5.5/7.5 kW 1500/12000 min^{-1}	7.5/11 kW 1500/6000 min^{-1}	7.5/11 kW 1500/6000 min^{-1}	
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	←	10000000	10000000	10000000	
6508	3008	3008	4008	00000001	←	00000001	00000001	00000000	
6509	3009	3009	4009	00000000	←	00000000	00000000	00000000	
6511	3011	3011	4011	00001010	←	00001010	00001010	00001010	
6512	3012	3012	4012	00000000	←	00000000	00000000	00000000	
6513	3013	3013	4013	00100110	←	00111110	00111110	00111110	
6519	3019	3019	4019	00001100	←	00001100	00001100	00001100	
6520	3020	3020	4020	6000	8000*	4500	6000	4500	
6539	3039	3039	4039	0	←	0	0	0	
6580	3080	3080	4080	65	←	60	65	50	
6600	3100	3100	4100	1500	←	1340	1600	1150	
6601	3101	3101	4101	100	←	90	90	100	
6602	3102	3102	4102	1500	←	1220	1450	1150	
6603	3103	3103	4103	1500	←	1220	1450	1150	
6604	3104	3104	4104	1300	←	1000	500	800	
6605	3105	3105	4105	1300	←	1000	500	800	
6606	3106	3106	4106	1200	←	2000	2000	2000	
6607	3107	3107	4107	1200	←	2000	2000	2000	
6608	3108	3108	4108	300	←	300	300	300	
6609	3109	3109	4109	10	←	10	10	10	
6610	3110	3110	4110	924	←	1223	826	1132	
6611	3111	3111	4111	28	←	38	31	33	
6612	3112	3112	4112	333	←	278	347	347	
6613	3113	3113	4113	150	←	95	100	130	
6614	3114	3114	4114	15	←	10	10	0	
6615	3115	3115	4115	5	←	5	5	0	
6616	3116	3116	4116	100	←	105	106	130	
6617	3117	3117	4117	20	←	20	20	30	
6618	3118	3118	4118	30	←	50	50	10	
6619	3119	3119	4119	0	←	0	0	0	
6620	3120	3120	4120	50	←	100	100	60	
6624	3124	3124	4124	0	←	0	0	0	
6627	3127	3127	4127	142	←	148	146	146	
6628	3128	3128	4128	0	←	0	0	0	
6629	3129	3129	4129	0	←	0	0	0	
6630	3130	3130	4130	0	←	0	0	0	
6933	3313	3169	4169	0	←	0	0	0	

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Motor model name				αP8	αP8/8000	αP12	αP12/8000		
Applicable amplifier				SPM–11	SPM–11	SPM–11	SPM–11		
Model code (applicable software)				112 (9D00/G)	–	112 (9D00/G)	–		
Output specifications / Parameter No.				3.7/5.5 kW 750/6000 min^{-1}	3.7/5.5 kW 750/8000 min^{-1}	5.5/7.5 kW 750/6000 min^{-1}	5.5/7.5 kW 750/8000 min^{-1}		
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	←	10000000	←		
6508	3008	3008	4008	00000001	←	00000000	←		
6509	3009	3009	4009	00100000	←	00000000	←		
6511	3011	3011	4011	00111010	←	00111010	←		
6512	3012	3012	4012	00000000	←	00000000	←		
6513	3013	3013	4013	00011010	←	00011010	←		
6519	3019	3019	4019	00001100	←	00001100	←		
6520	3020	3020	4020	6000	8000*	6000	8000*		
6539	3039	3039	4039	0	←	0	←		
6580	3080	3080	4080	50	40*	50	←		
6600	3100	3100	4100	750	←	610	←		
6601	3101	3101	4101	90	←	100	←		
6602	3102	3002	4002	1040	←	1000	←		
6603	3103	3003	4003	1040	←	1000	←		
6604	3104	3004	4004	2000	←	2000	←		
6605	3105	3005	4005	2000	←	2000	←		
6606	3106	3006	4006	2000	←	1500	←		
6607	3107	3007	4007	2000	←	1500	←		
6608	3108	3008	4008	300	←	300	←		
6609	3109	3009	4009	10	←	10	←		
6610	3110	3110	4110	774	←	794	←		
6611	3111	3111	4111	23	←	27	←		
6612	3112	3112	4112	500	←	500	←		
6613	3113	3113	4113	420	←	140	←		
6614	3114	3114	4114	0	←	8	←		
6615	3115	3115	4115	5	←	5	←		
6616	3116	3116	4116	100	←	107	←		
6617	3117	3117	4117	20	←	20	←		
6618	3118	3118	4118	30	←	30	←		
6619	3119	3119	4119	0	←	0	←		
6620	3120	3120	4120	38	←	40	←		
6624	3124	3124	4124	0	←	0	←		
6627	3127	3127	4127	178	←	164	←		
6628	3128	3128	4128	10000	←	6000	←		
6629	3129	3129	4129	0	←	0	←		
6630	3130	3130	4130	0	←	0	←		
6933	3313	3169	4169	0	←	0	←		

Motor model name				αP15	αP15/8000	αP15	αP18	αP18/8000	αP18
Applicable amplifier				SPM–15	SPM–15	SPM–15	SPM–15	SPM–15	SPM–15
Model code (applicable software)				114 (9D00/G)	–	–	115(9D00/G)		–
Output specifications / Parameter No.				7.5/9 kW 750/6000 min^{-1}	7.5/9 kW 750/8000 min^{-1}	7.5/9 kW 750/6000 min^{-1}	3.7/5.5 kW 750/6000 min^{-1}	3.7/5.5kW 750/8000 min^{-1}	5.5/7.5 kW 500/6000 min^{-1}
FS0	FS15	FS15i	FS16i/16						
6507	3007	3007	4007	10000000	←	←	10000000	←	←
6508	3008	3008	4008	00000001	←	←	00000000	←	←
6509	3009	3009	4009	00000000	←	←	00000000	←	←
6511	3011	3011	4011	00111010	←	←	00111010	←	←
6512	3012	3012	4012	00000000	←	←	00000000	←	←
6513	3013	3013	4013	00011010	←	←	00011010	←	←
6519	3019	3019	4019	00001100	←	←	00001100	←	←
6520	3020	3020	4020	6000	8000*	6000	6000	8000*	6000
6539	3039	3039	4039	0	←	←	0	←	←
6580	3080	3080	4080	50	←	←	65	←	←
6600	3100	3100	4100	760	←	510*	800	←	530*
6601	3101	3101	4101	100	←	←	100	←	95*
6602	3102	3102	4102	1134	←	←	1010	←	←
6603	3103	3103	4103	1134	←	←	1010	←	←
6604	3104	3104	4104	2000	←	←	2000	←	←
6605	3105	3105	4105	2000	←	←	2000	←	←
6606	3106	3106	4106	1500	←	←	1500	←	←
6607	3107	3107	4107	1500	←	←	1500	←	←
6608	3108	3108	4108	500	←	←	500	←	←
6609	3109	3109	4109	10	←	←	10	←	←
6610	3110	3110	4110	984	←	←	743	←	←
6611	3111	3111	4111	28	←	←	25	←	←
6612	3112	3112	4112	533	←	←	533	←	←
6613	3113	3113	4113	140	←	←	135	←	←
6614	3114	3114	4114	12	←	←	10	←	←
6615	3115	3115	4115	7	←	←	0	←	←
6616	3116	3116	4116	100	←	←	100	←	←
6617	3117	3117	4117	20	←	←	20	←	←
6618	3118	3118	4118	30	←	←	10	←	←
6619	3119	3119	4119	0	←	←	0	←	←
6620	3120	3120	4120	40	←	←	40	←	←
6624	3124	3124	4124	0	←	←	0	←	←
6627	3127	3127	4127	144	←	178*	147	←	164*
6628	3128	3128	4128	6500	←	0*	5500	←	30000*
6629	3129	3129	4129	0	←	←	0	←	←
6630	3130	3130	4130	0	←	←	0	←	←
6933	3313	3169	4169	0	←	←	0	←	←

Motor model name				αP22	αP22/8000	αP22	αP30	αP30	
Applicable amplifier				SPM–22	SPM–22	SPM–22	SPM–22	SPM–22	
Model code (applicable software)				116 (9D00/G)	–	–	116 (9D00/G)		
Output specifications / Parameter No.				11/15 kW 750/6000 min^{-1}	11/15 kW 750/8000 min^{-1}	7.5/11 kW 550/6000 min^{-1}	15/18.5 kW 575/4500 min^{-1}	15/18.5 kW 575/6000 min^{-1}	
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	←	←	10000000	←	
6508	3008	3008	4008	00000000	←	←	00000000	←	
6509	3009	3009	4009	00000000	←	←	00000000	←	
6511	3011	3011	4011	00111010	←	←	00111010	←	
6512	3012	3012	4012	00000000	←	←	00000000	←	
6513	3013	3013	4013	00100110	←	←	00100110	←	
6519	3019	3019	4019	00001100	←	←	00001100	←	
6520	3020	3020	4020	6000	8000*	6000	4500	6000*	
6539	3039	3039	4039	47	←	←	0	←	
6580	3080	3080	4080	55	←	←	50	←	
6600	3100	3100	4100	810	←	600*	575	←	
6601	3101	3101	4101	100	←	←	100	←	
6602	3102	3102	4102	1090	←	←	650	←	
6603	3103	3103	4103	1090	←	←	650	←	
6604	3104	3104	4104	1400	←	←	2000	←	
6605	3105	3105	4105	1400	←	←	2000	←	
6606	3106	3106	4106	1500	←	←	1500	←	
6607	3107	3107	4107	1500	←	←	1500	←	
6608	3108	3108	4108	300	←	←	300	←	
6609	3109	3109	4109	10	←	←	10	←	
6610	3110	3110	4110	914	←	←	750	←	
6611	3111	3111	4111	30	←	←	26	←	
6612	3112	3112	4112	500	←	←	500	←	
6613	3113	3113	4113	130	←	←	115	←	
6614	3114	3114	4114	12	←	←	10	←	
6615	3115	3115	4115	5	←	←	5	←	
6616	3116	3116	4116	100	←	←	100	←	
6617	3117	3117	4117	20	←	←	20	←	
6618	3118	3118	4118	30	←	←	10	←	
6619	3119	3119	4119	0	←	←	0	←	
6620	3120	3120	4120	30	←	←	30	←	
6624	3124	3124	4124	0	←	←	0	←	
6627	3127	3127	4127	164	←	176*	148	←	
6628	3128	3128	4128	5500	←	←	3000	←	
6629	3129	3129	4129	0	←	←	0	←	
6630	3130	3130	4130	0	←	←	0	←	
6933	3313	3169	4169	3600	←	←	0	←	

Motor model name				αP40	α5				
Applicable amplifier				SPM–26	SPM–11				
Model code (applicable software)				118 (9D0A/A)	119 (9D0A/A)				
Output specifications / Parameter No.				18.5/22 kW 575/4500 min^{-1}	22/30 kW 575/4500 min^{-1}				
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000				
6508	3008	3008	4008	00000000	00000001				
6509	3009	3009	4009	00000000	00000000				
6511	3011	3011	4011	00111010	00111010				
6512	3012	3012	4012	00000000	00000000				
6513	3013	3013	4013	00100110	00100110				
6519	3019	3019	4019	00001100	00001100				
6520	3020	3020	4020	4500	4500				
6539	3039	3039	4039	0	53				
6580	3080	3080	4080	40	50				
6600	3100	3100	4100	620	670				
6601	3101	3101	4101	100	100				
6602	3102	3102	4102	830	670				
6603	3103	3103	4103	830	600				
6604	3104	3104	4104	2800	3000				
6605	3105	3105	4105	2800	3000				
6606	3106	4306	4106	2000	1500				
6607	3107	3107	4107	2000	1500				
6608	3108	3108	4108	300	300				
6609	3109	3109	4109	10	10				
6610	3110	3110	4110	1104	1006				
6611	3111	3111	4111	31	33				
6612	3112	3112	4112	417	417				
6613	3113	3113	4113	100	90				
6614	3114	3114	4114	10	0				
6615	3115	3115	4115	12	0				
6616	3116	3116	4116	90	90				
6617	3117	3117	4117	20	20				
6618	3118	3118	4118	10	30				
6619	3119	3119	4119	0	0				
6620	3120	3120	4120	40	40				
6624	3124	3124	4124	0	0				
6627	3127	3127	4127	143	164				
6628	3128	3128	4128	0	0				
6629	3129	3129	4129	0	0				
6630	3130	3130	4130	0	0				
6933	3313	3169	4169	0	3600				

Motor model name				αP60					
Applicable amplifier				SPM–30					
Model code (applicable software)				174 (9D0A/A)					
Output specifications / Parameter No.				Low speed 18.5/30 kW 400/1500 min^{-1} High speed 22/30 kW 750/4500 min^{-1}					
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000					
6508	3008	3008	4008	00000011					
6509	3009	3009	4009	00000000					
6511	3011	3011	4011	00111010					
6512	3012	3012	4012	00000000					
6513	3013	3013	4013	00100110					
6519	3019	3019	4019	00001100					
6520	3020	3020	4020	4500					
6539	3039	3039	4039	0					
6580	3080	3080	4080	50					
6600	3100	3100	4100	750					
6601	3101	3101	4101	100					
6602	3102	3102	4102	750					
6603	3103	3103	4103	750					
6604	3104	3104	4104	2500					
6605	3105	3105	4105	2500					
6606	3106	3106	4106	1500					
6607	3107	3107	4107	1500					
6608	3108	3108	4108	300					
6609	3109	3109	4109	10					
6610	3110	3110	4110	1059					
6611	3111	3111	4111	30					
6612	3112	3112	4112	313					
6613	3113	3113	4113	85					
6614	3114	3114	4114	10					
6615	3115	3115	4115	5					
6616	3116	3116	4116	130					
6617	3117	3117	4117	20					
6618	3118	3118	4118	30					
6619	3119	3119	4119	0					
6620	3120	3120	4120	40					
6624	3124	3124	4124	0					
6627	3127	3127	4127	195*					
6628	3128	3128	4128	0					
6629	3129	3129	4129	0					
6630	3130	3130	4130	0					
6902	3282	3138	4138	360					
6903	3283	3139	4139	100					
6904	3284	3140	4140	360					
6905	3285	3141	4141	360					

Motor model name				αP60					
Applicable amplifier				SPM–30					
Model code (applicable software)				174 (9D0A/A)					
Output specifications / Parameter No.				Low speed 18.5/30 kW 400/1500 min^{-1} High speed 22/30 kW 750/4500 min^{-1}					
FS0	FS15	FS15*i*	FS16*i*/16						
6906	3286	3142	4142	3000					
6907	3287	3143	4143	1500					
6908	3288	3144	4144	300					
6909	3289	3145	4145	10					
6910	3290	3146	4146	2011					
6911	3291	3147	4147	62					
6912	3292	3148	4148	313					
6913	3293	3149	4149	80					
6914	3294	3150	4150	0					
6915	3295	3151	4151	5					
6916	3296	3152	4152	130					
6917	3297	3153	4153	20					
6918	3298	3154	4154	10					
6919	3299	3155	4155	0					
6920	3300	3156	4156	0					
6922	3302	3158	4158	0					
6923	3303	3159	4159	0					
6925	3305	3161	4161	0					
6930	3310	3166	4166	40*					
6933	3313	3169	4169	0					

C.3 SPINDLE MOTOR α T Series

Motor model name				αT6/12000	αT8/12000	αT15/10000	αT22/10000		
Applicable amplifier				SPM–11	SPM–11	SPM–22	SPM–26		
Model code (applicable software)				106 (9D00/G)	107 (9D00/G)	109 (9D00/G)	111 (9D00/G)		
Output specifications / Parameter No.				5.5/7.5 kW 1500/12000 min^{-1}	7.5/11 kW 1500/12000 min^{-1}	15/18.5 kW 1500/10000 min^{-1}	22/26 kW 1500/10000 min^{-1}		
FS0	FS15	FS15*i*	FS16*i*/16						
6501	3001	3001	4001	00000101*	00000101*	00000101*	00000101*		
6503	3003	3003	4003	00010010*	00010010*	00000010*	00000010*		
6507	3007	3007	4007	10000000	10000000	10000000	10000000		
6508	3008	3008	4008	00000001	00000001	00000001	00000001		
6509	3009	3009	4009	00000000	00000000	00000000	00000000		
6511	3011	3011	4011	00001001*	00001001*	00001010	00001010		
6512	3012	3012	4012	00000000	00000000	00000000	00000000		
6513	3013	3013	4013	00011010	00011010	00100110	00100110		
6519	3019	3019	4019	00001100	00001100	00001100	00001100		
6520	3020	3020	4020	12000*	12000*	10000*	10000*		
6539	3039	3039	4039	0	0	150	0		
6580	3080	3080	4080	50*	55*	70	65		
6600	3100	3100	4100	1500	1590	1600	1500		
6601	3101	3101	4101	100	100	100	100		
6602	3102	3102	4102	1730	1590	1600	1500		
6603	3103	3103	4103	1730	1590	1600	1500		
6604	3104	3104	4104	1500	1500	1300	1300		
6605	3105	3105	4105	1500	1500	1300	1300		
6606	3106	3106	4106	1500	1500	1200	1200		
6607	3107	3107	4107	1500	1500	1200	1200		
6608	3108	3108	4108	300	300	300	300		
6609	3109	3109	4109	10	10	10	10		
6610	3110	3110	4110	629	503	862	924		
6611	3111	3111	4111	17	20	26	28		
6612	3112	3112	4112	1000	1000	500	333		
6613	3113	3113	4113	450	400	160	150		
6614	3114	3114	4114	10	20	12*	15		
6615	3115	3115	4115	5	5	10	5		
6616	3116	3116	4116	100	100	100	100		
6617	3117	3117	4117	20	20	20	20		
6618	3118	3118	4118	30	30	25	30		
6619	3119	3119	4119	0	0	0	0		
6620	3120	3120	4120	38	40	50	50		
6624	3124	3124	4124	0	0	0	0		
6627	3127	3127	4127	164	176	148	142		
6628	3128	3128	4128	7000	0	0	0		
6629	3129	3129	4129	0	0	0	0		
6630	3130	3130	4130	0	0	0	0		
6933	3313	3169	4169	0	0	3600	0		

C.4 SPINDLE MOTOR α L Series

Motor model name				αL15/10000	αL22/10000	αL26/10000			
Applicable amplifier				SPM–15	SPM–22	SPM–30			
Model code (applicable software)				–	–	–			
Output specifications / Parameter No.				Low speed 9/11 kW 500/2000 min^{-1} High speed 15/18.5 kW 2000/10000 min^{-1}	Low speed 11/15 kW 500/2000 min^{-1} High speed 18.5/22 kW 2000/10000 min^{-1}	Low speed 15/18.5 kW 500/2000 min^{-1} High speed 9/11 kW 2000/10000 min^{-1}			
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	10000000			
6508	3008	3008	4008	00000001	00000001	00000000			
6509	3009	3009	4009	00000000	00000000	00000000			
6511	3011	3011	4011	00001010	00001010	00001010			
6512	3012	3012	4012	00000000	00000000	00000000			
6513	3013	3013	4013	00011010	00100110	00100110			
6519	3019	3019	4019	00001100	00001100	00001100			
6520	3020	3020	4020	10000	10000	10000			
6523	3023	3023	4023	175	162	168			
6539	3039	3039	4039	0	0	0			
6580	3080	3080	4080	75	69	50			
6600	3100	3100	4100	2000	2000	2000			
6601	3101	3101	4101	90	100	100			
6602	3102	3002	4002	2000	2000	2000			
6603	3103	3003	4003	2000	2000	2000			
6604	3104	3004	4004	800	800	500			
6605	3105	3005	4005	800	800	500			
6606	3106	3006	4006	1200	1500	1500			
6607	3107	3007	4007	1200	1500	1500			
6608	3108	3008	4008	300	300	300			
6609	3109	3009	4009	10	10	10			
6610	3110	3110	4110	539	862	855			
6611	3111	3111	4111	16	28	19			
6612	3112	3112	4112	333	500	333			
6613	3113	3113	4113	160	130	180			
6614	3114	3114	4114	0	14	15			
6615	3115	3115	4115	5	5	5			
6616	3116	3116	4116	100	100	100			
6617	3117	3117	4117	20	20	20			
6618	3118	3118	4118	30	30	50			
6619	3119	3119	4119	0	0	0			
6620	3120	3120	4120	30	35	50			
6624	3124	3124	4124	0	0	0			
6627	3127	3127	4127	147	164	148			
6628	3128	3128	4128	10000	0	0			
6629	3129	3129	4129	0	0	0			

Motor model name				αL15/10000	αL22/10000	αL26/10000			
Applicable amplifier				SPM–15	SPM–22	SPM–30			
Model code (applicable software)				–	–	–			
Output specifications / Parameter No.				Low speed 9/11 kW 500/2000 min^{-1} High speed 15/18.5 kW 2000/10000 min^{-1}	Low speed 11/15 kW 500/2000 min^{-1} High speed 18.5/22 kW 2000/10000 min^{-1}	Low speed 15/18.5 kW 500/2000 min^{-1} High speed 9/11 kW 2000/10000 min^{-1}			
FS0	FS15	FS15*i*	FS16*i*/16						
6630	3130	3130	4130	0	0	0			
6902	3282	3138	4138	500	500	500			
6903	3283	3139	4139	100	100	100			
6904	3284	3140	4140	500	600	700			
6905	3285	3141	4141	500	600	700			
6906	3286	3142	4142	1800	1600	1500			
6907	3287	3143	4143	1600	1500	1500			
6908	3288	3144	4144	300	300	300			
6909	3289	3145	4145	10	10	10			
6910	3290	3146	4146	1331	1207	1331			
6911	3291	3147	4147	45	40	40			
6912	3292	3148	4148	333	800	200			
6913	3293	3149	4149	160	200	180			
6914	3294	3150	4150	0	13	0			
6915	3295	3151	4151	2	5	5			
6916	3296	3152	4152	100	100	100			
6917	3297	3153	4153	20	20	20			
6918	3298	3154	4154	30	20	10			
6919	3299	3155	4155	0	0	0			
6920	3300	3156	4156	0	0	0			
6922	3302	3158	4158	0	1500	0			
6923	3303	3159	4159	0	0	0			
6925	3305	3161	4161	0	0	0			
6930	3310	3166	4166	50	65	70			
6933	3313	3169	4169	0	0	0			

C.5 SPINDLE MOTOR α HV Series

Motor model name				α6HV	α8HV	α12HV	α15/HV	α18HV	α22HV
Applicable amplifier				SPM–11HV	SPM–11HV	SPM–15HV	SPM–26HV	SPM–26HV	SPM–26HV
Model code (applicable software)				–	–	–	130 (9D0A/A)	131 (9D0A/A)	132 (9D0A/A)
Output specifications / Parameter No.				5.5/7.5 kW 1500/8000 min^{-1}	7.5/11 kW 1500/6000 min^{-1}	11/15 kW 1500/6000 min^{-1}	15/18.5 kW 1500/6000 min^{-1}	18.5/22 kW 1500 /6000 min^{-1}	22/26 kW 1500 /6000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	10000000	10000000	10000000	10000000
6508	3008	3008	4008	00000000	00000001	00000001	00000001	00000000	00000001
6509	3009	3009	4009	00000000	00000000	00000000	00000000	100000	00000000
6511	3011	3011	4011	00001010	00001010	00001010	00001010	00001010	00001010
6512	3012	3012	4012	00000000	00000000	00000000	00000000	00000000	00000000
6513	3013	3013	4013	00011010	00011010	00011010	00011010	00011010	00011010
6519	3019	3019	4019	00001100	00001100	00001100	00001100	00001100	00001100
6520	3020	3020	4020	8000	6000	6000	6000	6000	6000
6539	3039	3039	4039	0	0	0	0	0	0
6580	3080	3080	4080	65	70	65	60	60	60
6600	3100	3100	4100	1500	1500	1500	1600	1560	1560
6601	3101	3101	4101	100	100	100	100	88	100
6602	3102	3102	4102	1500	1500	1500	1600	1560	1560
6603	3103	3103	4103	1350	1350	1400	1300	1500	1400
6604	3104	3104	4104	1200	1000	1500	1300	1500	1500
6605	3105	3105	4105	1200	1000	1500	1300	1500	1500
6606	3106	3106	4106	1500	1000	1500	1500	1500	1500
6607	3107	3107	4107	1500	1000	1500	1500	1500	1500
6608	3108	3108	4108	300	300	300	300	300	300
6609	3109	3109	4109	10	10	10	10	10	10
6610	3110	3110	4110	687	629	1160	1470	838	838
6611	3111	3111	4111	16	23	30	31	24	24
6612	3112	3112	4112	3000	1000	750	500	500	500
6613	3113	3113	4113	440	330	140	140	180	180
6614	3114	3114	4114	0	20	16	10	0	20
6615	3115	3115	4115	0	5	5	0	5	5
6616	3116	3116	4116	100	100	100	120	100	100
6617	3117	3117	4117	20	20	20	20	20	20
6618	3118	3118	4118	30	30	30	0	30	30
6619	3119	3119	4119	0	0	0	0	0	0
6620	3120	3120	4120	35	35	30	30	30	30
6624	3124	3124	4124	0	0	0	0	0	0
6627	3127	3127	4127	164	176	164	148	143	142
6628	3128	3128	4128	0	0	0	0	6000	0
6629	3129	3129	4129	0	0	0	0	0	0

Motor model name				α6HV	α8HV	α12HV	α15/HV	α18HV	α22HV
Applicable amplifier				SPM–11HV	SPM–11HV	SPM–15HV	SPM–26HV	SPM–26HV	SPM–26HV
Model code (applicable software)				–	–	–	130 (9D0A/A)	131 (9D0A/A)	132 (9D0A/A)
Output specifications / Parameter No.				5.5/7.5 kW 1500/8000 min^{-1}	7.5/11 kW 1500/6000 min^{-1}	11/15 kW 1500/6000 min^{-1}	15/18.5 kW 1500/6000 min^{-1}	18.5/22 kW 1500/6000 min^{-1}	22/26 kW 1500/6000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6630	3130	3130	4130	0	0	0	0	0	0
6933	3313	3169	4169	0	0	0	0	0	0

Motor model name				α30HV	α40HV	α60HV			
Applicable amplifier				SPM–45HV	SPM–45HV	SPM–75HV			
Model code (applicable software)				133 (9D0A/A)	134 (9D0A/A)	133 (9D0A/A)			
Output specifications / Parameter No.				30/37 kW 1150/4500 min^{-1}	37/45 kW 1500/6000 min^{-1}	60/75 kW 1150/4500 min^{-1}			
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	10000000			
6508	3008	3008	4008	00000000	00000001	00000001			
6509	3009	3009	4009	00000000	00000000	00000000			
6511	3011	3011	4011	00001010	00001010	00001010			
6512	3012	3012	4012	00000000	00000000	00000000			
6513	3013	3013	4013	00101010	00101010	00101010			
6519	3019	3019	4019	00001100	00001100	00001100			
6520	3020	3020	4020	4500	6000	4500			
6539	3039	3039	4039	0	0	0			
6580	3080	3080	4080	60	60	75			
6600	3100	3100	4100	1150	1500	1150			
6601	3101	3101	4101	100	100	100			
6602	3102	3102	4102	1150	1500	1150			
6603	3103	3103	4103	1000	1350	1000			
6604	3104	3104	4104	1500	1200	1200			
6605	3105	3105	4105	1500	1200	1200			
6606	3106	3106	4106	1500	1500	1500			
6607	3107	3107	4107	1500	1500	1500			
6608	3108	3108	4108	300	300	300			
6609	3109	3109	4109	10	10	10			
6610	3110	3110	4110	1078	718	1183			
6611	3111	3111	4111	29	27	36			
6612	3112	3112	4112	500	500	1000			
6613	3113	3113	4113	105	95	85			
6614	3114	3114	4114	14	0	13			
6615	3115	3115	4115	3	3	3			
6616	3116	3116	4116	100	105	115			
6617	3117	3117	4117	20	20	20			
6618	3118	3118	4118	30	20	30			
6619	3119	3119	4119	0	0	0			
6620	3120	3120	4120	50	50	50			

Motor model name				α30HV	α40HV	α60HV			
Applicable amplifier				SPM–45HV	SPM–45HV	SPM–75HV			
Model code (applicable software)				133 (9D0A/A)	134 (9D0A/A)	133 (9D0A/A)			
Output specifications Parameter No.				30/37 kW 1150/4500 min^{-1}	37/45 kW 1500/6000 min^{-1}	60/75 kW 1150/4500 min^{-1}			
6624	3124	3124	4124	0	0	0			
6627	3127	3127	4127	148	146	150			
6628	3128	3128	4128	0	0	0			
6629	3129	3129	4129	0	0	0			
6630	3130	3130	4130	0	0	0			
6933	3313	3169	4169	0	0	0			

C.6 BUILT–IN SPINDLE MOTOR α Series

Motor model name				αB80M –1.5/15000	αB80L –1.1/8000	αB100S –2.2/8000	αB112S –3.7/6000	αB112M –5.5/10000	αB160S –5.5/6000
Parameter drawing No.				L150	L143	L140	L151	L141	L152
Applicable amplifier				SPM–2.2	SPM–5.5	SPM–5.5	SPM–11	SPM–11	SPM–22
Model code (applicable software)				101 (9D00/G)	102 (9D00/G)	120 (9D00/O)	122 (9D0A/A)	121 (9D00/O)	123 (9D0A/A)
Output specifications / Parameter No.				1.5/2.2 kW 3000/15000 min^{-1}	1.1/3.7 kW 1500/8000 min^{-1}	2.2/3.7 kW 1500/8000 min^{-1}	3.7/5.56 kW 1500/6000 min^{-1}	5.5/7.5 kW 1500/10000 min^{-1}	5.5/7.5 kW 600/6000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	10000000	10000000	10000000	10000000
6508	3008	3008	4008	00000000	00000000	00000000	00000000	00000000	00000000
6509	3009	3009	4009	00000000	00000000	00000000	00000000	00000000	00000000
6511	3011	3011	4011	00001001*	00001001*	00001010*	00001001*	00001010*	00001001*
6512	3012	3012	4012	00000000	00000000	00000000	00000000	00000000	00000000
6513	3013	3013	4013	00011010	00011010	00011010	00011010	00011010	00100110
6519	3019	3019	4019	00001100	00001100	00001100	00001100	00001100	00001100
6520	3020	3020	4020	15000*	8000	8000	6000	10000	6000
6539	3039	3039	4039	0	0	0	0	0	0
6540	3040	3040	4040		3*	7*			
6548	3048	3048	4048		3*	7*			
6580	3080	3080	4080	60	60	60	65	35	70
6600	3100	3100	4100	3000	1500	1500	2000	1900	630
6601	3101	3101	4101	100	100	93	100	100	100
6602	3102	3102	4102	3000	2000	2352	2000	1900	1700
6603	3103	3103	4103	3000	2000	2352	2000	1750	1700
6604	3104	3104	4104	1500	1500	1500	1300	1600	1000
6605	3105	3105	4105	1500	1500	1500	1300	1600	1000
6606	3106	3106	4106	1500	1500	1500	1500	1500	1500
6607	3107	3107	4107	1500	1500	1500	1500	1500	1500
6608	3108	3108	4108	500	500	300	300	300	300
6609	3109	3109	4109	10	10	10	10	10	10
6610	3110	3110	4110	629	377	585	1369	838	1257
6611	3111	3111	4111	8	13	22	38	29	49
6612	3112	3112	4112	652	652	783	1000	500	500
6613	3113	3113	4113	1550	1600	550	425	350	180
6614	3114	3114	4114	10	10	10	20	0	30
6615	3115	3115	4115	3	2	2	0	0	0
6616	3116	3116	4116	100	100	115	110	100	100
6617	3117	3117	4117	20	20	20	20	20	20
6618	3118	3118	4118	10	10	10	20	20	20
6619	3119	3119	4119	0	0	0	0	0	0
6620	3120	3120	4120	40	40	35	35	35	35
6624	3124	3124	4124	0	0	0	0	0	0
6627	3127	3127	4127	176	403	202	178	163	164

Motor model name				αB80M –1.5/15000	αB80L –1.1/8000	αB100S –2.2/8000	αB112S –3.7/6000	αB112M –5.5/10000	αB160S –5.5/6000
Parameter drawing No.				**L150**	**L143**	**L140**	**L151**	**L141**	**L152**
Applicable amplifier				**SPM–2.2**	**SPM–5.5**	**SPM–5.5**	**SPM–11**	**SPM–11**	**SPM–22**
Model code (applicable software)				**101 (9D00/G)**	**102 (9D00/G)**	**120 (9D00/O)**	**122 (9D0A/A)**	**121 (9D00/O)**	**123 (9D0A/A)**
Output specifications / Parameter No.				**1.5/2.2 kW 3000/15000 min^{-1}**	**1.1/3.7 kW 1500/8000 min^{-1}**	**2.2/3.7 kW 1500/8000 min^{-1}**	**3.7/5.56 kW 1500/6000 min^{-1}**	**5.5/7.5 kW 1500/10000 min^{-1}**	**5.5/7.5 kW 600/6000 min^{-1}**
FS0	FS15	FS15*i*	FS16*i*/16						
6628	3128	3128	4128	0	16000	8000	0	0	32000
6629	3129	3129	4129	0	0	0	0	0	0
6630	3130	3130	4130	0	0	0	0	0	0
6933	3313	3169	4169	0	0	0	0	0	0

Motor model name				αB112L –5.5/12000	αB112L –18.5/14000	αB112LL –5.5/12000	αB112LL –18.5/12000	αB132L –5.5/12000	αB132L –22/12000
Parameter drawing No.				L510	L511	L512	L513	L514	L520
Applicable amplifier				SPM–15	SPM–30	SPM–22	SPM–30	SPM–15	SPM–30
Model code (applicable software)				165 (9D00/O)	166(9D00/O)	167 (9D00/O)	168 (9D00/O)	169 (9D00/O)	175 (9D0A/A)
Output specifications / Parameter No.				Low speed 5.5/7.5 kW 680/1600 min^{-1} High speed 5.5/7.5 kW 1600/12000 min^{-1}	Low speed 15/18.5 kW 1500/3500 min^{-1} High speed 18.5/22 kW 5000/14000 min^{-1}	Low speed 5.5/7.5 kW 450/1000 min^{-1} High speed 5.5/7.5 kW 1000/12000 min^{-1}	Low speed 15/18.5 kW 1200/4000 min^{-1} High speed 18.5/22 kW 3500/12000 min^{-1}	Low speed 5.5/7.5 kW 330/1500 min^{-1} High speed 5.5/7.5 kW 1500/12000 min^{-1}	Low speed 15/22 kW 750/3000 min^{-1} High speed 22/25 k W 5500/12000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	10000000	10000000	10000000	10000000
6508	3008	3008	4008	00000000	00000000	00000000	00000000	00000000	00000001
6509	3009	3009	4009	00000000	00000000	00000000	00000000	00000000	00000000
6511	3011	3011	4011	00001010*	00001010*	00001010*	00001010*	00001010*	00001010*
6512	3012	3012	4012	00000000	00000000	00000000	00000000	00000000	00000000
6513	3013	3013	4013	00011010	00100110	00100110	00100110	00011010	00100110
6519	3019	3019	4019	00001100	00001100	00001100	00001100	00001100	00001100
6520	3020	3020	4020	12000	14000	12000	12000	12000	12000
6523	3023	3023	4023	133*	250*	83*	217*	125*	250*
6539	3039	3039	4039	0	0	0	0	0	0
6541	3041	3041	4041	4*	3*	3*	4*	4*	4*
6549	3049	3049	4049	4*	3*	3*	4*	4*	4*
6580	3080	3080	4080	80	100	90	60	75	53
6600	3100	3100	4100	1700	7000	1050	3500	1650	6000
6601	3101	3101	4101	100	100	100	85	100	100
6602	3102	3102	4102	2500	7000	1900	4000	2500	6000
6603	3103	3103	4103	2500	7000	1900	4000	2500	6000
6604	3104	3104	4104	1000	300	1100	600	950	400
6605	3105	3105	4105	1000	300	1100	600	950	400
6606	3106	3106	4106	1500	1500	1500	1500	100	1500
6607	3107	3107	4107	1500	1500	1500	1500	100	1500
6608	3108	3108	4108	300	300	500	300	300	300
6609	3109	3109	4109	10	10	10	10	10	10
6610	3110	3110	4110	707	1206	838	1006	944	928
6611	3111	3111	4111	22	30	21	29	27	31
6612	3112	3112	4112	2667	1250	500	833	333	2500
6613	3113	3113	4113	450	480	500	500	150	150
6614	3114	3114	4114	10	30	20	20	10	30
6615	3115	3115	4115	2	5	5	0	5	2
6616	3116	3116	4116	100	100	100	110	100	120
6617	3117	3117	4117	20	20	20	20	30	20
6618	3118	3118	4118	10	20	10	20	10	20
6619	3119	3119	4119	0	0	0	0	0	0
6620	3120	3120	4120	30	35	50	35	30	55
6624	3124	3124	4124	0	0	0	0	0	0
6627	3127	3127	4127	164	148	164	148	164	176
6628	3128	3128	4128	16000	0	15000	12000	9000	0
6629	3129	3129	4129	0	0	0	0	0	0

Motor model name				αB112L –5.5/12000	αB112L –18.5/14000	αB112LL –5.5/12000	αB112LL –18.5/12000	αB132L –5.5/12000	αB132L –22/12000
Parameter drawing No.				L510	L511	L512	L513	L514	L520
Applicable amplifier				SPM–15	SPM–30	SPM–22	SPM–30	SPM–15	SPM–30
Model code (applicable software)				165 (9D00/O)	166(9D00/O)	167 (9D00/O)	168 (9D00/O)	169 (9D00/O)	175 (9D0A/A)
Output specifications / Parameter No.				Low speed 5.5/7.5 kW 680/1600 min^{-1} High speed 5.5/7.5 kW 1600/12000 min^{-1}	Low speed 15/18.5 kW 1500/3500 min^{-1} High speed 18.5/22 kW 5000/14000 min^{-1}	Low speed 5.5/7.5 kW 450/1000 min^{-1} High speed 5.5/7.5 kW 1000/12000 min^{-1}	Low speed 15/18.5 kW 1200/4000 min^{-1} High speed 18.5/22 kW 3500/12000 min^{-1}	Low speed 5.5/7.5 kW 330/1500 min^{-1} High speed 5.5/7.5 kW 1500/12000 min^{-1}	Low speed 15/22 kW 750/3000 min^{-1} High speed 22/25 k W 5500/12000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6630	3130	3130	4130	0	25	0	0	0	38
6902	3282	3138	4138	1000	1800	520	1500	380	1300
6903	3283	3139	4139	100	100	100	100	100	100
6904	3284	3140	4140	1000	1800	900	1500	750	1300
6905	3285	3141	4141	1000	1800	900	1500	750	1300
6906	3286	3142	4142	1000	1500	2000	800	2000	1500
6907	3287	3143	4143	1500	1500	1500	1500	1500	1500
6908	3288	3144	4144	300	300	500	300	300	300
6909	3289	3145	4145	10	10	10	10	10	10
6910	3290	3146	4146	1508	2011	1676	2011	1886	3017
6911	3291	3147	4147	50	53	55	60	63	100
6912	3292	3148	4148	667	313	500	417	333	417
6913	3293	3149	4149	350	550	350	350	160	110
6914	3294	3150	4150	10	10	20	10	15	0
6915	3295	3151	4151	5	5	0	5	5	5
6916	3296	3152	4152	100	120	100	100	100	100
6917	3297	3153	4153	20	20	20	20	20	20
6918	3298	3154	4154	10	20	10	10	0	10
6919	3299	3155	4155	0	0	0	0	0	0
6920	3300	3156	4156	15	0	0	0	0	0
6922	3302	3158	4158	0	0	0	0	3800	0
6923	3303	3159	4159	0	0	0	0	0	0
6925	3305	3161	4161	0	0	0	0	0	0
6930	3310	3166	4166	60*	80*	70*	55*	65*	100*
6933	3313	3169	4169	240	0	0	0	0	0

Motor model name				αB160M –5.5/7000	αB160M –11/6000	αB160L –7.5/12000	αB160LL –25/13000	αB180M –11/6000	αB180L –22/6000
Parameter drawing No.				L509	L534	L515	L516	L517	L525
Applicable amplifier				SPM–15	SPM–30	SPM–22	SPM–30	SPM–30	SPM–30
Model code (applicable software)				164 (9D00/O)	176 (9D0A/A)	170 (9D00/O)	171 (9D00/O)	172 (9D00/O)	177 (9D0A/A)
Output specifications / Parameter No.				Low speed 5.5/7.5 kW 450/1000 min^{-1} High speed 5.5/7.5 kW 1000/7000 min^{-1}	Low speed 5.5/7.5 kW 300/850 min^{-1} High speed 11/18.5 kW 850/6000 min^{-1}	Low speed 7.5/11 kW 450/800 min^{-1} High speed 7.5/11 kW 800/12000 min^{-1}	Low speed 15/22 kW 600/3000 min^{-1} High speed 25/30 kW 2500/13000 min^{-1}	Low speed 11/15 kW 450/800 min^{-1} High speed 11/15 kW 800/6000 min^{-1}	Low speed 18.5/22 kW 500/1500 min^{-1} High speed 22/25 kW 1500/6000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	10000000	10000000	10000000	10000000
6508	3008	3008	4008	00000000	00000000	00000000	000000011	00000000	00000001
6509	3009	3009	4009	00000000	00000000	00000000	00000000	00000000	00000000
6511	3011	3011	4011	00001010*	00111010*	00001010*	00001010*	00001010*	00001010*
6512	3012	3012	4012	00000000	00000000	00000000	00000000	00000000	00000000
6513	3013	3013	4013	00011010	00100110	00100110	00100110	00100110	00100110
6519	3019	3019	4019	00001100	00001100	00001100	00001100	00001100	00001100
6520	3020	3020	4020	7000	6000	12000	13000	6000	6000
6523	3023	3023	4023	143*	142*	67*	131*	133*	167*
6539	3039	3039	4039	0	0	0	0	0	0
6540	3040	3040	4040		8*				
6541	3041	3041	4041		6*		7*		8*
6548	3048	3048	4048		8*				
6549	3049	3049	4049		6*		7*		8*
6580	3080	3080	4080	66	30	70	50	66	55
6600	3100	3100	4100	1080	1300	900	2500	1000	1750
6601	3101	3101	4101	66	100	95	100	100	100
6602	3102	3102	4102	1203	1300	1700	2500	1875	1750
6603	3103	3103	4103	1203	1300	1500	2500	1700	1750
6604	3104	3104	4104	1400	1000	1000	1000	1200	1100
6605	3105	3105	4105	1400	1000	1000	1000	1200	1100
6606	3106	3106	4106	1500	1500	1500	1500	1200	1500
6607	3107	3107	4107	1500	1500	1500	1500	1200	1500
6608	3108	3108	4108	300	300	300	300	300	300
6609	3109	3109	4109	10	10	10	10	10	10
6610	3110	3110	4110	984	2414	1006	1140	2624	2155
6611	3111	3111	4111	31	75	37	41	69	72
6612	3112	3112	4112	333	313	1000	417	313	667
6613	3113	3113	4113	140	180	180	180	75	70
6614	3114	3114	4114	15	0	0	7	0	10
6615	3115	3115	4115	0	0	5	5	0	0
6616	3116	3116	4116	100	100	100	100	130	120
6617	3117	3117	4117	20	20	20	20	20	20
6618	3118	3118	4118	20	20	10	50	20	20
6619	3119	3119	4119	0	0	0	0	0	0
6620	3120	3120	4120	35	50	50	50	35	50
6624	3124	3124	4124	0	0	0	0	0	0
6627	3127	3127	4127	164	202	176	176	164	164

Motor model name				αB160M –5.5/7000	αB160M –11/6000	αB160L –7.5/12000	αB160LL –25/13000	αB180M –11/6000	αB180L –22/6000
Parameter drawing No.				L509	L534	L515	L516	L517	L525
Applicable amplifier				SPM–15	SPM–30	SPM–22	SPM–30	SPM–30	SPM–30
Model code (applicable software)				164 (9D00/O)	176 (9D0A/A)	170 (9D00/O)	171 (9D00/O)	172 (9D00/O)	177 (9D0A/A)
Output specifications / Parameter No.				Low speed 5.5/7.5 kW 450/1000 min^{-1} High speed 5.5/7.5 kW 1000/7000 min^{-1}	Low speed 5.5/7.5 kW 300/850 min^{-1} High speed 11/18.5 kW 850/6000 min^{-1}	Low speed 7.5/11 kW 450/800 min^{-1} High speed 7.5/11 kW 800/12000 min^{-1}	Low speed 15/22 kW 600/3000 min^{-1} High speed 25/30 kW 2500/13000 min^{-1}	Low speed 11/15 kW 450/800 min^{-1} High speed 11/15 kW 800/6000 min^{-1}	Low speed 18.5/22 kW 500/1500 min^{-1} High speed 22/25 kW 1500/6000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6628	3128	3128	4128	3000	0	20000	0	0	0
6629	3129	3129	4129	0	0	0	0	0	0
6630	3130	3130	4130	0	0	0	0	0	0
6902	3282	3138	4138	520	300	450	600	562	530
6903	3283	3139	4139	73	100	100	100	100	100
6904	3284	3140	4140	601	750	600	600	562	530
6905	3285	3141	4141	601	750	600	600	562	530
6906	3286	3142	4142	1500	1000	2500	1000	1200	2500
6907	3287	3143	4143	1500	1500	1500	1500	1200	1500
6908	3288	3144	4144	300	300	300	300	300	300
6909	3289	3145	4145	10	10	10	10	10	10
6910	3290	3146	4146	1331	4309	1006	1631	3771	2413
6911	3291	3147	4147	44	90	32	50	99	77
6912	3292	3148	4148	333	313	500	417	150	208
6913	3293	3149	4149	160	130	200	180	75	80
6914	3294	3150	4150	10	0	20	0	20	0
6915	3295	3151	4151	0	0	5	5	0	0
6916	3296	3152	4152	100	100	100	100	120	100
6917	3297	3153	4153	20	20	20	20	20	20
6918	3298	3154	4154	20	20	10	50	20	20
6919	3299	3155	4155	0	0	0	0	0	0
6920	3300	3156	4156	0	0	53	0	0	0
6922	3302	3158	4158	0	0	0	0	0	0
6923	3303	3159	4159	0	0	0	0	0	0
6925	3305	3161	4161	0	0	53	0	0	0
6930	3310	3166	4166	66*	40*	70*	85*	45*	27*
6933	3313	3169	4169	0	0	240	0	0	0

Motor model name				αB160M –5.5/7000	αB160M –11/6000				
Parameter drawing No.				L518	L536				
Applicable amplifier				SPM–30	SPM–45				
Model code (applicable software)				173 (9D00/O)	178 (9D0A/A)				
Output specifications / Parameter No.				Low speed 18.5/22 kW 350/1500 min^{-1} High speed 22/25 kW 1300/8000 min^{-1}	Low speed 15/22 kW 290/650 min^{-1} High speed 15/22 kW 650/4500 min^{-1}				
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000				
6508	3008	3008	4008	00000000	00000000				
6509	3009	3009	4009	00000000	00000000				
6511	3011	3011	4011	00001010*	10000010*				
6512	3012	3012	4012	00000000	00000000				
6513	3013	3013	4013	00100110	00111110				
6519	3019	3019	4019	00001100	00001100				
6520	3020	3020	4020	8000	4500				
6523	3023	3023	4023	150*	144*				
6539	3039	3039	4039	0	0				
6580	3080	3080	4080	65	50				
6600	3100	3100	4100	1500	1300				
6601	3101	3101	4101	100	100				
6602	3102	3102	4102	1500	1300				
6603	3103	3103	4103	1500	1300				
6604	3104	3104	4104	1200	1500				
6605	3105	3105	4105	1200	1500				
6606	3106	3106	4106	1500	1500				
6607	3107	3107	4107	1500	1500				
6608	3108	3108	4108	300	300				
6609	3109	3109	4109	10	10				
6610	3110	3110	4110	862	1212				
6611	3111	3111	4111	21	38				
6612	3112	3112	4112	417	370				
6613	3113	3113	4113	100	150				
6614	3114	3114	4114	10	10				
6615	3115	3115	4115	5	5				
6616	3116	3116	4116	100	100				
6617	3117	3117	4117	20	20				
6618	3118	3118	4118	10	10				
6619	3119	3119	4119	0	0				
6620	3120	3120	4120	50	80				
6624	3124	3124	4124	0	0				
6627	3127	3127	4127	136	176				
6628	3128	3128	4128	0	0				
6629	3129	3129	4129	0	0				
6630	3130	3130	4130	0	0				
6902	3282	3138	4138	500	450				

Motor model name				αB160M –5.5/7000	αB160M –11/6000				
Parameter drawing No.				L518	L536				
Applicable amplifier				SPM–30	SPM–45				
Model code (applicable software)				173 (9D00/O)	178 (9D0A/A)				
Output specifications / Parameter No.				Low speed 18.5/22 kW 350/1500 min^{-1} High speed 22/25 kW 1300/8000 min^{-1}	Low speed 15/22 kW 290/650 min^{-1} High speed 15/22 kW 650/4500 min^{-1}				
FS0	FS15	FS15*i*	FS16*i*/16						
6903	3283	3139	4139	100	100				
6904	3284	3140	4140	500	450				
6905	3285	3141	4141	500	450				
6906	3286	3142	4142	1000	2400				
6907	3287	3143	4143	1500	1500				
6908	3288	3144	4144	300	300				
6909	3289	3145	4145	10	10				
6910	3290	3146	4146	1724	1234				
6911	3291	3147	4147	50	39				
6912	3292	3148	4148	417	370				
6913	3293	3149	4149	90	400				
6914	3294	3150	4150	10	10				
6915	3295	3151	4151	5	5				
6916	3296	3152	4152	100	100				
6917	3297	3153	4153	20	20				
6918	3298	3154	4154	10	10				
6919	3299	3155	4155	0	0				
6920	3300	3156	4156	42	0				
6922	3302	3158	4158	0	0				
6923	3303	3159	4159	0	0				
6925	3305	3161	4161	0	0				
6930	3310	3166	4166	70*	50*				
6933	3313	3169	4169	1800	0				

Motor model name				αB100S –11/20000					
Parameter drawing No.				L174					
Applicable amplifier				SPM–22					
Model code (applicable software)				124 (9D0A/A)					
Output specifications / Parameter No.				11/15 kW 7500/20000 min^{-1}					
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000					
6508	3008	3008	4008	00000000					
6509	3009	3009	4009	00000000					
6511	3011	3011	4011	00001010*					
6512	3012	3012	4012	00000000					
6513	3013	3013	4013	00100110					
6519	3019	3019	4019	00001100					
6520	3020	3020	4020	20000					
6539	3039	3039	4039	0					
6540	3040	3040	4040	8*					
6548	3048	3048	4048	8*					
6580	3080	3080	4080	80					
6600	3100	3100	4100	11000					
6601	3101	3101	4101	100					
6602	3102	3102	4102	11000					
6603	3103	3103	4103	9000					
6604	3104	3104	4104	400					
6605	3105	3105	4105	400					
6606	3106	3106	4106	800					
6607	3107	3107	4107	800					
6608	3108	3108	4108	300					
6609	3109	3109	4109	10					
6610	3110	3110	4110	1077					
6611	3111	3111	4111	33					
6612	3112	3112	4112	1500					
6613	3113	3113	4113	580					
6614	3114	3114	4114	10					
6615	3115	3115	4115	5					
6616	3116	3116	4116	100					
6617	3117	3117	4117	20					
6618	3118	3118	4118	20					
6619	3119	3119	4119	0					
6620	3120	3120	4120	55					
6624	3124	3124	4124	50*					
6627	3127	3127	4127	163					
6628	3128	3128	4128	0					
6629	3129	3129	4129	0					
6630	3130	3130	4130	45					
6933	3313	3169	4169	0					

Motor model name				αB100L–11/25000	αB112M–15/20000	αB112L–18.5/20000	αB112L–18.5/24000	αB160LL–22/15000	
Parameter drawing No.				L549	L522	L546	L541	L528	
Applicable amplifier				SPM–30	SPM–30	SPM–30	SPM–30(*1)	SPM–30	
Model code (applicable software)				179 (9D0A/A)	180 (9D0A/A)	181 (9D0A/A)	182 (9D0A/A)	183 (9D0A/A)	
Output specifications / Parameter No.				Low speed 11/15 kW 5500/9000 min^{-1} High speed 11/15 kW 9000/25000 min^{-1}	Low speed 10/15 kW 1500/4500 min^{-1} High speed 15/18.5 kW 10000/20000 min^{-1}	Low speed 15/18.5 kW 1800/4000 min^{-1} High speed 18.5/22 kW 8000/20000 min^{-1}	Low speed 15/18.5 kW 1800/4000 min^{-1} High speed 18.5/22 kW 9000/24000 min^{-1}	Low speed 15/22 kW 600/3000 min^{-1} High speed 22/25 kW 8000/15000 min^{-1}	
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	10000000	10000000	10000000	10000000	10000000	
6508	3008	3008	4008	00000000	00000000	00000000	00000000	00000000	
6509	3009	3009	4009	00000000	00000000	00000000	00000000	00000000	
6511	3011	3011	4011	00000000*	00001010*	00011010*	00011010*	00001010*	
6512	3012	3012	4012	00000000	00000000	00000010	00000000	00000000	
6513	3013	3013	4013	00100110	10100110	00100110	10100110	00100110	
6519	3019	3019	4019	00001100	00101100*	00101100*	00101100*	00001100	
6520	3020	3020	4020	25000	20000	20000	24000	15000	
6523	3023	3023	4023	360*	225*	200*	167*	200*	
6539	3039	3039	4039	0	0	0	0	0	
6541	3041	3041	4041		4*	4*	4*	8*	
6549	3049	3049	4049		4*	4*	4*	8*	
6580	3080	3080	4080	80	63	100	100	90	
6600	3100	3100	4100	11000	15000	7500	10000	8000	
6601	3101	3101	4101	100	100	90	65	100	
6602	3102	3102	4102	11000	15000	7500	7500	8000	
6603	3103	3103	4103	11000	13000	7500	7500	8000	
6604	3104	3104	4104	700	240	350	350	500	
6605	3105	3105	4105	700	240	350	350	500	
6606	3106	3106	4106	1000	600	1500	1000	1500	
6607	3107	3107	4107	1000	600	1500	1000	1500	
6608	3108	3108	4108	300	300	500	500	300	
6609	3109	3109	4109	10	10	10	10	10	
6610	3110	3110	4110	1775	1725	1006	1078	1207	
6611	3111	3111	4111	26	45	28	31	35	
6612	3112	3112	4112	2000	2500	417	417	3333	
6613	3113	3113	4113	450	330	400	420	200	
6614	3114	3114	4114	10	0	10	10	10	
6615	3115	3115	4115	0	0	5	5	2	
6616	3116	3116	4116	100	100	100	100	100	
6617	3117	3117	4117	20	20	20	20	20	
6618	3118	3118	4118	20	0	20	20	20	
6619	3119	3119	4119	0	0	200	200	0	
6620	3120	3120	4120	50	90	35	55	40	
6624	3124	3124	4124	0	200*	0	0	0	
6627	3127	3127	4127	164	180	148	148	176	
6628	3128	3128	4128	0	0	0	13501	0	
6629	3129	3129	4129	0	0	0	0	0	

Motor model name				αB100L–11/25000	αB112M–15/20000	αB112L–18.5/20000	αB112L–18.5/24000	αB160LL–22/15000	
Parameter drawing No.				L549	L522	L546	L541	L528	
Applicable amplifier				SPM–30	SPM–30	SPM–30	SPM–30(*1)	SPM–30	
Model code (applicable software)				179 (9D0A/A)	180 (9D0A/A)	181 (9D0A/A)	182 (9D0A/A)	183 (9D0A/A)	
Output specifications / Parameter No.				Low speed 11/15 kW 5500/9000 min^{-1} High speed 11/15 kW 9000/25000 min^{-1}	Low speed 10/15 kW 1500/4500 min^{-1} High speed 15/18.5 kW 10000/20000 min^{-1}	Low speed 15/18.5 kW 1800/4000 min^{-1} High speed 18.5/22 kW 8000/20000 min^{-1}	Low speed 15/18.5 kW 1800/4000 min^{-1} High speed 18.5/22 kW 9000/24000 min^{-1}	Low speed 15/22 kW 600/3000 min^{-1} High speed 22/25 kW 8000/15000 min^{-1}	
FS0	FS15	FS15*i*	FS16*i*/16						
6630	3130	3130	4130	0	100	50	55	0	
6902	3282	3138	4138	5500	1950	2000	2000	800	
6903	3283	3139	4139	100	100	100	100	100	
6904	3284	3140	4140	5500	2187	2000	2000	800	
6905	3285	3141	4141	5500	2187	2000	2000	800	
6906	3286	3142	4142	700	1000	1500	1500	1500	
6907	3287	3143	4143	1000	1000	1500	1500	1500	
6908	3288	3144	4144	300	300	500	500	300	
6909	3289	3145	4145	10	10	10	10	10	
6910	3290	3146	4146	2514	1206	1774	1774	1258	
6911	3291	3147	4147	39	30	41	33	37	
6912	3292	3148	4148	1000	313	417	417	833	
6913	3293	3149	4149	550	650	450	600	220	
6914	3294	3150	4150	17	0	0	0	10	
6915	3295	3151	4151	0	0	5	5	5	
6916	3296	3152	4152	100	100	100	100	100	
6917	3297	3153	4153	20	20	20	20	20	
6918	3298	3154	4154	20	20	20	20	20	
6919	3299	3155	4155	0	0	0	0	0	
6920	3300	3156	4156	0	0	0	0	0	
6922	3302	3158	4158	0	9000	0	0	0	
6923	3303	3159	4159	0	0	0	0	0	
6925	3305	3161	4161	30	20	0	40	0	
6930	3310	3166	4166	80*	100*	80*	100*	70*	
6933	3313	3169	4169	0	0	0	0	0	

C.7 SPINDLE MOTOR α SERIES (FOR SPINDLE HRV CONTROL)

Parameter setting procedure

(1) Perform automatic parameter setting with the model code set to “0”. (If you do not want to change the adjusted parameters, do not perform automatic parameter setting.)

(2) Manually change the parameters according to the parameter table.

(3) Set the detector–related parameters according to the configuration of the detector.

(4) To enable the spindle HRV control parameters securely, turn the power off and on again.

NOTE

The spindle HRV control parameters are enabled for the following spindle amplifier and spindle software combination.
Spindle amplifier specification drawing :
A06B–6102–Hxxx#H520
A06B–6104–Hxxx#H520
Spindle software series : Series 9D20

Motor model name				α0.5	α1	α1/15000	α2	α3	α3/12000
Applicable SPM				SPM–2.2	SPM–2.2	SPM–2.2	SPM–5.5	SPM–5.5	SPM–5.5
Parameter No. \ Output specifications				0.55/1.1 kW 3000/8000 min^{-1}	1.5/2.2 kW 3000/8000 min^{-1}	1.5/2.2 kW 3000/15000 min^{-1}	2.2/3.7 kW 1500/8000 min^{-1}	3.7/5.5 kW 1500/8000 min^{-1}	3.7/5.5 kW 1500/12000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	00000000	00000000	←	00000000	00000000	←
6508	3008	3008	4008	00000000	00000000	←	00000000	00000000	←
6509	3009	3009	4009	00000000	00000000	←	00000000	00000000	←
6511	3011	3011	4011	00011000	00011001	←	00011001	00011001	←
6512	3012	3012	4012	10000010	10000000	←	10000000	10000000	←
6513	3013	3013	4013	00001110	00001110	←	00001110	00001110	←
6519	3019	3019	4019	00000100	00000100	←	00000100	00000100	←
6520	3020	3020	4020	8000	8000	15000	8000	8000	12000
6539	3039	3039	4039	0	0	←	0	0	←
6540	3040	3040	4040	2					
6548	3048	3048	4048	2					
6580	3080	3080	4080	83	70	←	77 80*1	70	←
6600	3100	3100	4100	3200	3100	←	1550	1600	←
6601	3101	3101	4101	95	100	←	100	100	←
6602	3102	3102	4102	6524	3557	←	2567	1967	←
6603	3103	3103	4103	0 40*1	0 87*1	← ←	0 68*1	0 75*1	← ←
6604	3104	3104	4104	1500	5540	←	4100	4500	←
6605	3105	3105	4105	0	0	←	0	0	←
6606	3106	3106	4106	3000	5540	←	4100	4500	←
6607	3107	3107	4107	0	0	←	0	0	←
6608	3108	3108	4108	0	0	←	0	–2000	←
6609	3109	3109	4109	25	25	←	25	25	←
6610	3110	3110	4110	1886	690	←	474	475	←
6611	3111	3111	4111	361	102	←	175	200	←
6612	3112	3112	4112	200	200	←	200	19400	←
6613	3113	3113	4113	1900	2100	←	1192	1077	←
6614	3114	3114	4114	0	17920	←	0	0	←
6615	3115	3115	4115	100	100	←	100	100	←
6616	3116	3116	4116	13842	10018	←	9300	7950	←
6617	3117	3117	4117	90	90	←	90	28250	←
6618	3118	3118	4118	100	100	←	100	110	←
6619	3119	3119	4119	5	5	←	8	5	←
6620	3120	3120	4120	0	0	←	0	0	←
6624	3124	3124	4124	0	0	←	0	0	←
6627	3127	3127	4127	240	176	←	202	178	←
6628	3128	3128	4128	0	0	←	90	0	←
6629	3129	3129	4129	0	0	←	0	0	←
6630	3130	3130	4130	25700	25700	←	25700	25700	←
6933	3313	3169	4169	0	0	←	0	0	←
Maximum output at acceleration (for PSM selection)				2.5 kW 1.32 kW*1	2.87 kW 2.64 kW*1	← ←	6.4 kW 4.44 kW*1	7.9 kW 6.6 kW*1	← ←

*1 The maximum–acceleration output is the same as for conventional control.

Motor model name				α6	α6/12000	α8	α8/8000	α12	α12 3/8000
Applicable SPM				SPM–11	SPM–11	SPM–11	SPM–11	SPM–15	SPM–15
Output specifications / Parameter No.				5.5/7.5 kW 1500/8000 min^{-1}	5.5/7.5 kW 1500/12000 min^{-1}	7.5/11 kW 1500/8000 min^{-1}	7.5/11 kW 1500/8000 min^{-1}	11/15 kW 1500/6000 min^{-1}	11/15 kW 1500/8000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	00000000	←	00000000	←	00000000	←
6508	3008	3008	4008	00000000	←	00000000	←	00000000	←
6509	3009	3009	4009	00000000	←	00000000	←	00000000	←
6511	3011	3011	4011	00011010	00011001	00011010	←	00011010	←
6512	3012	3012	4012	10000000	←	10000000	←	10000000	←
6513	3013	3013	4013	00001110	←	00001110	←	01010010	←
6519	3019	3019	4019	00000100	←	00000100	←	00000100	←
6520	3020	3020	4020	8000	12000	6000	8000	6000	8000
6539	3039	3039	4039	0	←	0	←	0	←
6580	3080	3080	4080	78 85*1	←	70	←	80	73
6600	3100	3100	4100	1550	←	1600	←	1612	←
6601	3101	3101	4101	100	←	100	←	90	←
6602	3102	3102	4102	1872	←	1656	←	1612	←
6603	3103	3103	4103	0 74*1	←	0	←	0	←
6604	3104	3104	4104	4000	←	4500	←	5300	←
6605	3105	3105	4105	0	←	0	←	0	←
6606	3106	400	4106	4000	←	4500	←	4900	←
6607	3107	3107	4107	0	←	0	←	0	←
6608	3108	3108	4108	0	←	0	←	0	←
6609	3109	3109	4109	25	←	25	←	25	←
6610	3110	3110	4110	626	←	503	←	718	←
6611	3111	3111	4111	168	←	170	←	220	←
6612	3112	3112	4112	200	←	200	←	200	←
6613	3113	3113	4113	848	←	790	←	305	←
6614	3114	3114	4114	0	←	19200	←	23040	←
6615	3115	3115	4115	90	←	100	←	100	←
6616	3116	3116	4116	7602	←	8118	←	5165	←
6617	3117	3117	4117	29530	←	90	←	90	←
6618	3118	3118	4118	110	←	100	←	100	←
6619	3119	3119	4119	1291	←	12	←	31	←
6620	3120	3120	4120	0	←	0	←	0	←
6624	3124	3124	4124	0	←	0	←	0	←
6627	3127	3127	4127	169	←	176	←	164	←
6628	3128	3128	4128	0	←	117	←	110	←
6629	3129	3129	4129	0	←	0	←	0	←
6630	3130	3130	4130	25700	←	25700	←	25700	←
6933	3313	3169	4169	0	←	0	←	0	←
Maximum output at acceleration (for PSM selection)				10.2 kW 9.0 kW*1	← ←	13.2 kW	←	18.0 kW	←

*1 The maximum–acceleration output is the same as for conventional control.

Motor model name				α15	α15 6/8000	α18	α18 8/8000	α22	α22 3/8000
Applicable SPM				SPM–22	SPM–22	SPM–22	SPM–22	SPM–26	SPM–26
Output specifications / Parameter No.				15/18.5 kW 1500/6000 min^{-1}	15/18.5 kW 1500/8000 min^{-1}	18.5/22 kW 1500/6000 min^{-1}	18.5/22 kW 1500/8000 min^{-1}	22/26 kW 1500/6000 min^{-1}	22/26 kW 1500/8000 min^{-1}
FS0	FS15	FS15*i*	FS16*i*/16						
6507	3007	3007	4007	00000000	←	00000000	←	00000000	←
6508	3008	3008	4008	00000000	←	00000000	←	00000000	←
6509	3009	3009	4009	00000000	←	00000000	←	00000000	←
6511	3011	3011	4011	00011010	←	00011010	←	00011010	←
6512	3012	3012	4012	10000000	←	10000000	←	10000000	←
6513	3013	3013	4013	01010010	←	01010010	←	01010010	←
6519	3019	3019	4019	00000100	←	00000100	←	00000100	←
6520	3020	3020	4020	6000	8000	6000	8000	6000	8000
6539	3039	3039	4039	0	←	0	←	0	←
6580	3080	3080	4080	75	←	85	←	80	←
6600	3100	3100	4100	1500	←	1400	←	1500	←
6601	3101	3101	4101	95	←	93	←	95	←
6602	3102	3102	4102	1710	←	1636	←	1756	←
6603	3103	3103	4103	0	←	0	←	0	←
6604	3104	3104	4104	4400	←	4000	←	4000	←
6605	3105	3105	4105	0	←	0	←	0	←
6606	3106	3106	4106	4100	←	4000	←	4000	←
6607	3107	3107	4107	0	←	0	←	0	←
6608	3108	3108	4108	0	←	0	←	0	←
6609	3109	3109	4109	25	←	25	←	25	←
6610	3110	3110	4110	794	←	670	←	924	←
6611	3111	3111	4111	243	←	230	←	252	←
6612	3112	3112	4112	200	←	150	←	200	←
6613	3113	3113	4113	304	←	260	←	290	←
6614	3114	3114	4114	23040	←	16640	←	0	←
6615	3115	3115	4115	100	←	100	←	100	←
6616	3116	3116	4116	5177	←	5028	←	5564	←
6617	3117	3117	4117	90	←	90	←	29530	←
6618	3118	3118	4118	100	←	90	←	110	←
6619	3119	3119	4119	31	←	34	←	29	←
6620	3120	3120	4120	0	←	0	←	0	←
6624	3124	3124	4124	0	←	0	←	0	←
6627	3127	3127	4127	148	←	143	←	142	←
6628	3128	3128	4128	105	←	0	←	105	←
6629	3129	3129	4129	0	←	0	←	0	←
6630	3130	3130	4130	25700	←	25700	←	25700	←
6933	3313	3169	4169	0	←	0	←	0	←
Maximum output at acceleration (for PSM selection)				22.2 kW	←	26.4 kW	←	31.2 kW	

*1 The maximum–acceleration output is the same as for conventional control.

D TABLE OF SIGNALS RELATED TO SPINDLE CONTROL

The CNC abbreviations used in the description stand for the following:

0C: Series 0–MC/0–TC
0TT: Tool post side 2 of Series 0–TT
15: Series 15
15*i*: Series 15*i*
16: Series 16, Series 18
16*i*/16: Series 16*i*, Series 16, Series 18*i*, Series 18

D.1 INPUT SIGNALS (PMC TO CNC) FOR SPINDLE CONTROL

0	0TT HEAD2	15	15*i*	16*i*/16(*2)	7	6	5	4	3	2	1	0
G229	G1429		G227	G070	MRDYA	ORCMA	SFRA	SRVA	CTH1A	CTH2A	TLMHA	TLMLA
G230	G1430	G226	G226	G071	RCHA	RSLA	INTGA	SOCNA	MCFNA	SPSLA	*ESPA	ARSTA
G231	G1431	G229	G229	G072	RCHHGA	MFNHGA	INCMDA	OVRA	DEFMDA	NRROA	ROTAA	INDXA
G232	G1432	G228	G228	G073					SORSLA	MPOFA	SLVA	MORCMA
G124	G1324			G032	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
G125	G1325			G033	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
		G024	G025		RISGN			RI12	RI11	RI10	RI09	RI08
		G025	G024		RI07	RI06	RI05	RI04	RI03	RI02	RI01	RI00
G110	G1310	G231	G230	G078	SHA07	SHA06	SHA05	SHA04	SHA03	SHA02	SHA01	SHA00
G111	G1311	G230	G231	G079					SHA11	SHA10	SHA09	SHA08
G103	G1303						SPC	SPB	SPA			
				G030	SOV7	SOV6	SOV5	SOV4	SOV3	SOV2	SOV1	SOV0
G120	G1320					*SSTP	SOR	SAR	FIN			
		G005	G005								FIN	
				G029		*SSTP	SOR	SAR				
				G004					FIN			
G123 (*1)	G1323				CON(M)	SPSTP	*SCPF	*SUCPF	GR2	GR1		COFF(T)
G118 (*1)	G1318								GR2	GR1		
				G027	CON(T/M)							
		G67,71..	G67,71..		SCNTR1,2..							
G146				G038					SSPHS	SPSYC		
	G111				SSPHS	SPSYC						
G123 (*3)											RGTP	
G135 (*3)				G061								RGTAP
		G026	G026			GS4	GS2	GS1	*SECLP	*SEUCL		SPSTP

0	0TT HEAD2	15	15*i*	16*i*/16(*2)	7	6	5	4	3	2	1	0
				G028		SPSTP	*SCPF	*SUCPF		GR2	GR1	
G104								ESRSYC				
G145	G1345				GR31	GR21	*SSTP3	*SSTP2	*SSTP1	SWS3	SWS2	SWS1
				G027			*SSTP3	*SSTP2	*SSTP1	SWS3	SWS2	SWS1
				G029						GR31		GR21
G146	G1346			G028	PS2SLC							

(*1) Depends on bit 5 (ADDCF) of parameter No. 31.
(*2) For information on the DI/DO addresses on the Head 2 side of the Series 16–TT, refer to the Series 16/18 connection manual (B–61803/03 or later).
(*3) Depends on bit 4 (SRGTP) of parameter No. 19.

D.2 INPUT SIGNALS (PMC TO CNC) FOR SECOND SPINDLE CONTROL

0	0TT HEAD2	15	15*i*	16/16*i*	7	6	5	4	3	2	1	0
G233	G1433	G235		G074	MRDYB	ORCMB	SFRB	SRVB	CTH1B	CTH2B	TLMHB	TLMLB
G234	G1434	G234		G075	RCHB	RSLB	INTGB	SOCNB	MCFNB	SPSLB	*ESPB	ARSTB
G236	G1436	G236		G076	RCHHGB	MFNHGB	INCMDB	OVRB	DEFMDB	NRROB	ROTAB	INDXB
G236	G1436	G236		G077					SORSLB	MPOFB	SLVB	MORCMB
G112	G1312	G239		G080	SHB07	SHB06	SHB05	SHB04	SHB03	SHB02	SHB01	SHB00
G113	G1313	G238		G081					SHB11	SHB10	SHB09	SHB08
G106	G1306				M2R08I	M2R07I	M2R06I	M2R05I	M2R04I	M2R03I	M2R02I	M2R01I
G107	G1307				M2SIND	M2SSIN	M2SGN		M2R12I	M2R11I	M2R10I	M2R09I
G108	G1308				M3R08I	M3R07I	M3R06I	M3R05I	M3R04I	M3R03I	M3R02I	M3R01I
G109	G1309				M3SIND	M3SSIN	M3SGN		M3R12I	M3R11I	M3R10I	M3R09I
				G034	R08I2	R07I2	R06I2	R05I2	R04I2	R03I2	R02I2	R01I2
				G035	SIND2	SSIN2	SGN2		R12I2	R11I2	R10I2	R09I2
				G036	R08I3	R07I3	R06I3	R05I3	R04I3	R03I3	R02I3	R01I3
				G037	SIND3	SSIN3	SGN3		R12I3	R11I3	R10I3	R09I3
		G232	G233		RISGNB			RIB12	RIB11	RIB10	RIB09	RIB08
		G233	G232		RIB07	RIB06	RIB05	RIB04	RIB03	RIB02	RIB01	RIB00

D.3 OUTPUT SIGNALS (CNC TO PMC) FOR FIRST SPINDLE CONTROL

0	0TT HEAD2	15	15*i*	16/16*i*	7	6	5	4	3	2	1	0
F281	F1481	F229		F045	ORARA	TLMA	LDT2A	LDT1A	SARA	SDTA	SSTA	ALMA
F282	F1482	F228		F046	MOAR2A	MOAR1A	POAR2A	SLVSA	RCFNA	RCHPA	CFINA	CHPA
F283	F1483	F231		F047					SORENA	MSOVRA	INCSTA	PC1DTA
F172	F1372			F036	R08O	R07O	R06O	R05O	R04O	R03O	R02O	R01O
F173	F1373			F037					R12O	R11O	R10O	R09O
		F010 (F006)			RO15	RO14	RO13	RO12	RO11	RO10	RO09	RO08
		F011 (F007)			RO07	RO06	RO05	RO04	RO03	RO02	RO01	RO00
F150	F1350			F007						SF		MF
		F008	F008								SF	MF
F149	F1349			F001				ENB				
F164	F1364			F038					ENB3	ENB2	SCLP	SUCLP
		F042	F042			SPCO	SPBO	SPAO		SPAL	SSLP	SUCLP
F154	F1354			F035								SPAL
F152	F1352			F034						GR30	GR20	GR10
		F001	F001		CSS							
				F002						CSS		
	F178			F044				SYCAL	FSPPH	FSPSY	FSCSL	
		F67,71..	F67,71..		MCNTR1,2..							
		F111			MSPPHS	MSPSYC	SPSYAL					
		F040	F040					RTAP				
		F020	F023	F025	S31	S30	S29	S28	S27	S26	S25	S24
		F021	F022	F024	S23	S22	S21	S20	S19	S18	S17	S16
		F022	F021	F023	S15	S14	S13	S12	S11	S10	S09	S08
		F023	F020	F022	S07	S06	S05	S04	S03	S02	S01	S00
		F012	F013	F041	AR15	AR14	AR13	AR12	AR11	AR10	AR09	AR08
		F013	F012	F040	AR07	AR06	AR05	AR04	AR03	AR02	AR01	AR00

0	0TT HEAD2	15	15*i*	16/16*i*	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
		F232	F233		SLDM15	SLDM14	SLDM13	SLDM12	SLDM11	SLDM10	SLDM09	SLDM08
		F233	F232		SLDM07	SLDM06	SLDM05	SLDM04	SLDM03	SLDM02	SLDM01	SLDM00
		F234	F235		SSPD15	SSPD14	SSPD13	SSPD12	SSPD11	SSPD10	SSPD09	SSPD08
		F235	F234		SSPD07	SSPD06	SSPD05	SSPD04	SSPD03	SSPD02	SSPD01	SSPD00
		F236	F236		SSPAA7	SSPAA6	SSPAA5	SSPAA4	SSPAA3	SSPAA2	SSPAA1	SSPAA0

(*) The codes for Series 15–TT are enclosed in parentheses.

D.4 OUTPUT SIGNALS (CNC TO PMC) FOR SECOND SPINDLE CONTROL

0	0TT HEAD2	15	15*i*	16/16*i*	7	6	5	4	3	2	1	0
F285	F1485	F245	F254	F049	ORARB	TLMB	LDT2B	LDT1B	SARB	SDTB	SSTB	ALMB
F286	F1486	F244	F244	F050	MOAR2B	MOAR1B	POAR2B	SLVSB	RCFNB	RCHPB	CFINB	CHPB
F287	F1487	F247	F247	F051					SORENB	MSOVRB	INCSTB	PC1DTB

ADDITIONAL INFORMATION

Revision of αC series Spindle software (9D12/D)

1. General

   αC series Spindle software was revised as follows.

2. ROM series, edition and applied PCB

ROM drawing No.	ROM edition	SPM specification	Applied PCB	Notes
A06B-6082-H512	9D12 edition D (04)	A06B-6082-Hxxx#H512	A20B-2001-0780 A20B-2001-0781 A16B-2202-0840	

3. Contents of modification

ROM series and edition	Contents
9D12/D	In automatic spindle parameter initialization, setting value of “load meter indication value at maximum output (No.4127: FS16*i*/16)” is modified as follows. (motor model) (modified) αC1.5 : 403 → **404** αC2 : 178 → **202** αC6 : 178 → **164** αC8 : 178 → **176** αC22 : 143 → **142** αC3 special : 204 → **205**

4. Parameter list

   Please refer to the following pages.

				TITLE Revision of αC series Spindle software (9D12/D)	
01	05.03.25	J.Tezuka		DRAW. No. B-65160E/02-01	CUST.
Ed.	Date	Design.		FANUC LTD	SHEET 1/3

Parameter table for αC series spindle software 9D12 series (1 of 2)

Model code				220	221	222	223	224	225
Parameter No.				αC1 1.5/2.2 kW 3000/6000 min^{-1}	αC1.5 1.1/3.7 kW 1500/6000 min^{-1}	αC2 2.2/3.7 kW 1500/6000 min^{-1}	αC3 3.7/5.5 kW 1500/6000 min^{-1}	αC6 5.5/7.5 kW 1500/6000 min^{-1}	αC8 7.5/11 kW 1500/6000 min^{-1}
0	15	15*i*	16*i*/16						
6511	3011	3011	4011	0000 1000	0000 1000	0000 1000	0000 1000	0000 1000	0000 1000
6513	3013	3013	4013	0000 1100	0000 1100	0000 1100	0000 1100	0000 1100	0000 1100
6520	3020	3020	4020	6000	6000	6000	6000	6000	6000
6540 ~ 41	3040 ~ 41	3040 ~ 41	4040 ~ 41	90	60	60	90	75	60
6542 ~ 45	3042 ~ 45	3042 ~ 45	4042 ~ 45	150	100	100	150	125	100
6548 ~ 49	3048 ~ 49	3048 ~ 49	4048 ~ 49	360	240	240	360	300	240
6550 ~ 53	3050 ~ 53	3050 ~ 53	4050 ~ 53	600	400	400	600	500	400
6580	3080	3080	4080	100	100	100	100	100	100
6583	3083	3083	4083	60	60	60	60	60	60
6584	3084	3084	4084	60	60	60	60	60	60
6585	3085	3085	4085	60	60	60	60	60	60
6600	3100	3100	4100	3000	2000	2038	1550	1730	1500
6601	3101	3101	4101	3000	1500	1700	1500	1700	1500
6602	3102	3102	4102	74	90	71	70	60	72
6603	3103	3103	4103	200	200	200	200	200	200
6604	3104	3104	4104	0	700	700	700	700	700
6605	3105	3105	4105	1300	1200	500	800	400	500
6606	3106	3106	4106	120	60	30	30	20	20
6607	3107	3107	4107	1024	1024	1024	1024	1024	1024
6608	3108	3108	4108	64	64	64	128	128	128
6610	3110	3110	4110	726	435	581	484	726	580
6611	3111	3111	4111	1000	1000	1000	1000	1000	1000
6612	3112	3112	4112	6000	6000	6000	6000	5000	6000
6613	3113	3113	4113	400	500	180	160	130	120
6615	3115	3115	4115	5000	0	0	0	0	0
6616	3116	3116	4116	168	160	150	159	158	150
6617	3117	3117	4117	200	230	200	200	200	230
6618	3118	3118	4118	20	20	50	50	50	40
6619	3119	3119	4119	3000	2000	1500	1500	1500	1500
6620	3120	3120	4120	15	15	15	15	15	15
6621	3121	3121	4121	5	5	5	5	5	5
6622	3122	3122	4122	20	20	20	20	20	20
6624	3124	3124	4124	2	2	2	2	2	2
6627	3127	3127	4127	176	404*	202*	178	164*	176*
6629	3129	3129	4129	10	30	30	30	30	30
6630	3130	3130	4130	200	200	200	200	250	200
6631	3131	3131	4131	500	400	300	400	200	300
6632	3132	3132	4132	1000	1212	1900	1700	1750	1950
6633	3133	3133	4133	220	221	222	223	224	225
Amplifier model				SPMC-2.2	SPMC-5.5	SPMC-5.5	SPMC-5.5	SPMC-11	SPMC-11
Software version				9D12/C	9D12/D	9D12/D	9D12/C	9D12/D	9D12/D

Note: Value with * is modified in 9D12/D.

Parameter table for αC series spindle software 9D12 series (2 of 2)

Model code				226	227	228	229	230	
Parameter No.				αC12 11/15 kW 1500/6000 min^{-1}	αC15 15/18.5 kW 1500/6000 min^{-1}	αC18 18.5/22 kW 1500/6000 min^{-1}	αC22 22/26kW 1500/6000 min^{-1}	αC3 special 4.4/7.5 kW 1500/6000 min^{-1}	
0	15	15*i*	16*i*/16						
6511	3011	3011	4011	0000 1000	0000 1000	0000 1000	0000 1000	0000 1000	
6513	3013	3013	4013	0001 1000	0001 0010	0001 0010	0001 0010	0000 1100	
6520	3020	3020	4020	6000	6000	4500	4500	6000	
6540 ~ 41	3040 ~ 41	3040 ~ 41	4040 ~ 41	150	120	150	120	75	
6542 ~ 45	3042 ~ 45	3042 ~ 45	4042 ~ 45	250	200	250	200	125	
6548 ~ 49	3048 ~ 49	3048 ~ 49	4048 ~ 49	600	480	600	480	300	
6550 ~ 53	3050 ~ 53	3050 ~ 53	4050 ~ 53	1000	800	1000	800	500	
6580	3080	3080	4080	100	100	100	100	100	
6583	3083	3083	4083	60	60	60	60	60	
6584	3084	3084	4084	60	60	60	60	60	
6585	3085	3085	4085	60	60	60	60	60	
6600	3100	3100	4100	1500	1600	1600	1500	1700	
6601	3101	3101	4101	1500	1600	1600	1500	1700	
6602	3102	3102	4102	67	40	42	38	80	
6603	3103	3103	4103	200	200	300	200	200	
6604	3104	3104	4104	700	700	700	700	700	
6605	3105	3105	4105	400	500	400	500	500	
6606	3106	3106	4106	10	10	10	10	30	
6607	3107	3107	4107	1024	1024	1024	1024	1024	
6608	3108	3108	4108	128	128	128	128	128	
6610	3110	3110	4110	1005	996	711	1067	830	
6611	3111	3111	4111	1000	1000	1000	1000	1000	
6612	3112	3112	4112	6000	6000	6000	6000	6000	
6613	3113	3113	4113	50	50	50	55	140	
6615	3115	3115	4115	0	0	0	0	0	
6616	3116	3116	4116	160	160	160	165	169	
6617	3117	3117	4117	230	230	300	250	200	
6618	3118	3118	4118	20	20	80	80	50	
6619	3119	3119	4119	1500	1600	1600	1500	1500	
6620	3120	3120	4120	55	50	50	50	15	
6621	3121	3121	4121	10	10	10	10	5	
6622	3122	3122	4122	20	20	20	20	20	
6624	3124	3124	4124	5	5	10	5	2	
6627	3127	3127	4127	164	148	143	142*	205*	
6629	3129	3129	4129	30	30	100	50	30	
6630	3130	3130	4130	150	200	150	200	200	
6631	3131	3131	4131	250	250	200	200	300	
6632	3132	3132	4132	2850	2750	2300	2700	1780	
6633	3133	3133	4133	226	227	228	229	230	
Amplifier model				SPMC-15	SPMC-22	SPMC-22	SPMC-26	SPMC-11	
Software version				9D12/C	9D12/C	9D12/C	9D12/D	9D12/D	

Note: Value with * is modified in 9D12/D.

				TITLE Revision of αC series Spindle software (9D12/D)
01	05.03.25	J.Tezuka		DRAW. No. B-65160E/02-01 / CUST.
Ed.	Date	Design.		FANUC LTD / SHEET 3/3

Correction of FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL

1. Type of applied documents

Name	FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL
Spec. No./Ver.	B-65160E/02

2. Summary of Change

Group	Name / Outline	New, Add Correct, Del	Applicable Date
Basic Function			
Optional Function			
Unit			
Maintenance Parts			
Notice			
Correction	The conversion formula of Current Prediction Constant for Spindle Switching Control and so on were corrected.	Correct	2006.12
Another			

				TITLE Correction of FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL
01	06.11.30	Tsutsumi		DRAW. No. B-65160E/02-02 CUST.
Ed.	Date	Design.		FANUC LTD SHEET 1/2

Correction of FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL

1. General

   Errors of FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL are informed.

2. Details of error

Item		Error	Correction
Page	Details		
75	(2.3.4 Detail of Parameter) the data range of MS signal constant	80 to 1000	81 to 1000
157	(2.8.4 Parameter Setting Procedure) the conversion formula of current prediction constant (*1)	IEST2 = IEST1 $\times \frac{G1}{G2}$	IEST2 = IEST1 $\times \frac{G2}{G1}$
159	(2.8.5 Details of Parameters Related to Spindle Switching Control) the conversion formula of current prediction constant (*1)	IEST2 = IEST1 $\times \frac{G1}{G2}$	IEST2 = IEST1 $\times \frac{G2}{G1}$
194	(3.1 SPINDLE PARAMETERS) the data range of MS signal constant	80 to 1000	81 to 1000
388	(C.6 BUILT-IN SPINDLE MOTOR α series) the parameter setting No.4080 of αB 100S-2.2/8000	60	70

*1 : The conversion formula of current conversion constant is right.

$$\text{ICONV2} = \text{ICONV1} \times \frac{G1}{G2}$$

				TITLE Correction of FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL
01	06.11.30	Tsutsumi		DRAW. No. B-65160E/02-02 · CUST.
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Revision Record

FANUC AC SPINDLE MOTOR α series PARAMETER MANUAL (B–65160E)

Edition	Date	Contents	Edition	Date	Contents
02	Sep., 2000	Addition of follows: ● Spindle HRV control ● Spindle prameters for αC series			
01	Apr., 1994				

B-65160E/02

* B - 6 5 1 6 0 E / 0 2 *